# THE EFFECTS OF BORDER VIOLENCE ON U.S.-MEXICAN CATTLE TRADE

A Thesis

by

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ABSTRACT

The purpose of this research is to identify the border closures' impact on the trade flows between Mexico and the United States and between different ports of entry. The aspects explored are 1) the closure forcing Mexican ranchers to transport their animals to the other ports of entry, causing the diversion of the cattle imports from Mexico or 2) its decreasing of the bilateral aggregate trade.

This research will identify and quantify the determinants of bilateral cattle trade between the United States and Mexico from January 2009 to September 2014. Data are collected from the World Institute for Strategic Economic Research (WISERTrade) and the United States Department of Agriculture Foreign Agricultural Service's Global Agricultural Trade System (the USDA FAS GATS). Due to local violence in Mexico and the continuation of safety concerns along the border region, some ports of entry for Mexican cattle imports into the United States have been closed. When a port of entry is closed, the USDA establishes temporary facilities for contingency livestock inspection to maintain the flow of trade across the US-Mexico border.

Through the use of a regression in Stata software, a series of economic explanatory variables, and a dummy variable for port of entry openings and closure the study attempts to measure how much of impact a closed port of entry has on the nearby ports of entry.

Using the ordinary least squares estimator (OLS) and the seemingly unrelated regression (SUR), the effects of border violence on U.S.-Mexican cattle trade are

determined. Given more benefits of using SUR for this study, the analysis indicates that the port closure at the Presidio port of entry has a statistically positive effect on the number of cattle crossings through the Santa Teresa port of entry and the temporary facility offsets the effect of port closure. The observed bilateral trade flows between two countries is explained well using SUR. This study illustrates that violence along the U.S.-Mexican border changes the flow of bilateral cattle trade; the ports are both positively and negatively impacted by border closures independent from distance.

# DEDICATION

To my family, thanks for all your support and encouragement when I needed it most. I love you all!

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I would like to express my gratitude to colleagues for making my time at Texas A&M University a great experience. In addition, I deeply appreciate the United States Department of Agriculture and WiserTrade for providing me with the data.

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TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

# 1. INTRODUCTION

Agricultural trade has become increasingly global over time. Implementation of the North American Free Trade Agreement (NAFTA) in 1994 led to significant increases in agricultural trade between the United States and Mexico. Much of the increase in agricultural trade is a result of economic growth in the two countries, reductions in trade barriers, and changing technology (Juan and Williams 2010). For the cattle industry, Mexico has the historic importance serving as a key exporter of feeder cattle to the United States, and the United States has been importing substantial numbers of cattle from Mexico to raise them as slaughter cattle for beef production (Peel, Mathews, and Jonson 2011). Given the vital role of cattle trade between United States and Mexico, it has been recognized that drug violence along the U.S.-Mexico border is affecting the bilateral cattle trade, threatening the safety of ranchers, farmers, and U.S. veterinarians in Mexico (Sherman 2010). The United States raises concerns that global terrorism, potential threats imposed by those entering the United States illegally, and fears of violence in Mexico might impact the United States have lead to border closures. These changes affect both domestic and international cattle and beef supply chain.

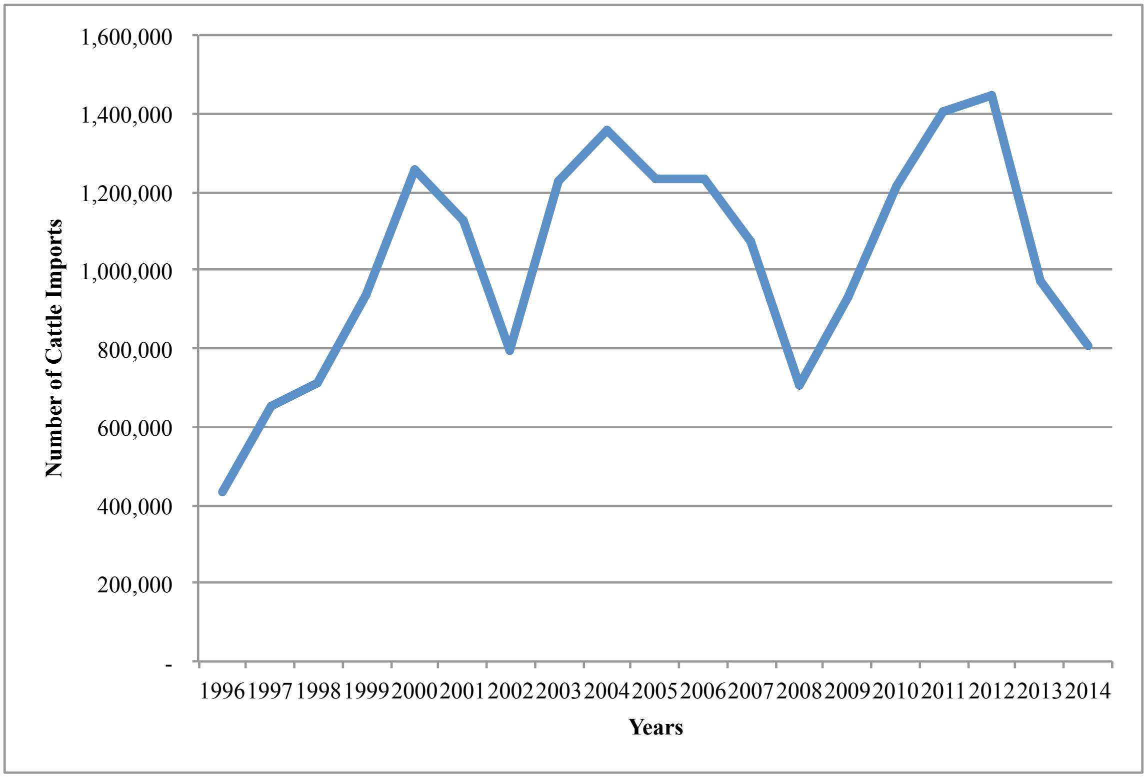
Knowing that the sustainable supply of feeder cattle is important for the United States due to our dependency on Mexican cattle for beef production, the objective of this study is to identify and quantify the impact of violence caused border closures that can change the movements of feeder cattle trade between the two countries. Using statistical methods, this work is intended to explore 1) closure forcing Mexican ranchers to transport their animals to the other ports of entry, causing the diversion of the cattle imports from Mexico or 2) closure causing decrease in the bilateral aggregate trade. This research will explore how border closures influence the trade flows of livestock crossings between the U.S.-Mexico border through different ports of entry from Mexico from January 2009 to September 2014. This analysis provides valuable information to stakeholders about the dynamics of cattle trade flow between the two countries and how it can change due to the port closure. It will specifically measure the implications of the incidence of violence at the U.S.- Mexican borders and their border closures, focusing on changes in trade flows of feeder cattle at the ports of entry.

## 2. OVERVIEW OF THE UNITED STATES CATTLE INDUSTRY

Cattle play a major role in agricultural trade between the United States and Mexico. Ever since the beginning of the NAFTA, “the cattle trades between the two countries significantly increased” (Skaggs et al. 2001). Especially for two countries who are sharing the international border, this reduction in the trade barrier promoted their economic growth and the total agricultural trade. However, as much as the regional integration upgraded cooperation, the cattle industry faces several challenges.

Historically, Mexico has a comparative advantage in production of feeder cattle and United States has a comparative advantage in production of beef (Peel, Mathews, Johnson 2011). In other words, producing feeder cattle is relatively cheaper in Mexico and producing slaughter cattle for beef production is relatively cheaper in the United States. So after NAFTA, the United States started to increase the number of exported beef to Mexico and imported feeder cattle from Mexico (Figure 1). Figure 1 shows a snapshot of the current situation of U.S. cattle industry providing monthly data for U.S. imports of Mexican feeder cattle from January 1996 to October 2014.

**Figure 1. Total U.S. Imports from January 1996 to September 2014**




Source: USDA, Agricultural Markets Service 2014

One distinct feature is a pattern across a few years with peaks and valleys recurring in six to seven year interval. Given the increasing trend, in 2011 and 2012, live cattle exports reached about 1.4 million head and 1.5 million head respectively; and in 2013, live cattle exports declined to 1.045 million head. It is essential to understand the numerous forces contributing to changes in the cattle trade between the United States and Mexico.

There is a seasonal pattern that impacts the U.S. cattle imports from Mexico. "All ports of entry have higher numbers of cattle crossing into the United States between

October and May and fewer imports from June to September" (Guinn and Skaggs 2005). Studies also indicated that the combined result of 2010/2011 drought which led to high feed costs in Mexico are other environmental factors causing higher number of cattle imports into the United States at each point of entry. According to Peel et al. (2010), feeder cattle for export to the United States are produced mainly in Tamaulipas and Chihuahua, the northern part Mexico, on large ranches so droughts in the northern Mexico will heavily influence feeder cattle movements from Mexico into the United States. This phenomenon implies that as rainfall decreases or if there is an unexpected droughts in northern Mexico trade increases.

Inspection process is another factor that influences cattle flow. According to the U.S. Department of Agriculture (USDA), "all cattle have to follow the U.S. health regulations before crossing; animals are dipped in insecticide before crossing into the United States and are inspected" (USDA APHIS 2014). To minimize the number of cattle being rejected at the border, cattle producers in Mexico face challenges including diseases and parasites causing bovine tuberculosis, brucellosis, rabies, and ticks (Peel et al. 2010). Cattle are refused at the port of entry annually due to failure to "comply with U.S. or Mexican paperwork or regulations, dipping certificates that are not in order, improper branding, evidence of open wounds or live ticks, or suspicions that the cattle in question may have been stolen in Mexico" (Mitchell et al. 2001).

Also, there are financial restrictions of fees associated with cattle being sold in the U.S. market. Even though the amount of fees and the inspection procedures could be a daunting process, the U.S. feeder cattle market is financially attractive to Mexican feeder cattle producers (Mitchell et al. 2001). The general relationship between cattle prices and exports is: as U.S. prices increase relative to Mexican prices (or as Mexican prices decrease relative to U.S. prices), Mexican cattle exports increase.

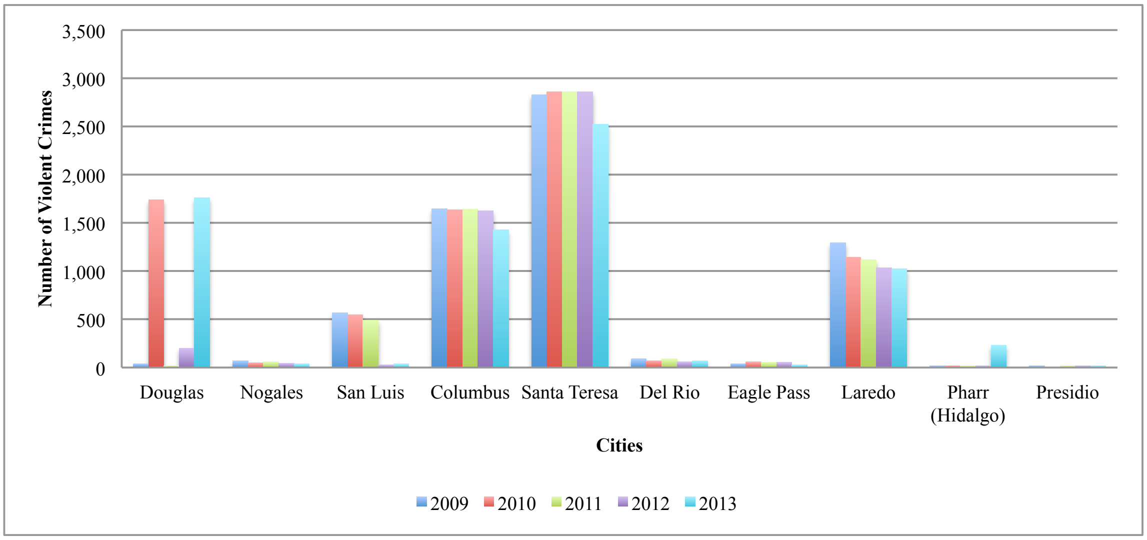
One of the factors that could influence the trade pattern in future years is a policy change in Mexico. During 2011, a better economy and the Government of Mexico's (GOM) supported for increased the slaughter and packing at Federally Inspected Facilities (TIF), stimulating the Mexican cattle industry (Juan and Williams 2010). Juan and Williams' report is also supported by Angadjivand who works at the USDA Economic Research Service. She argues that "the recent expansion of improved beef processing operations might lead to fewer feeder cattle availability for future exports to the United States" (Angadjivand et al. 2014). Referring to the vertical linkage method, improved beef processing operations and technology further stimulates an increasing trend of the Mexican beef exports. Juan and Williams (2010) states that for 2011, Mexican beef exports are forecast to increase 20 percent due to expanded market access into Russia, China, and Singapore. As Mexican beef exports increases, the decline of Mexico's cattle inventory will have negative implications of the U.S. cattle industry. This phenomenon implies that Mexico will be supplying fewer feeder cattle to the U.S. fed cattle market creating possible shortfalls to the U.S. Beef Industry overall.

While the Mexican government initiative aimed at expansion of slaughter at TIF facilities and technology development, Mexico needs to remain a strong cattle exporter to the United States to maintain the stable bilateral trade at the same time. This ability depends on the health and quality of the cattle and breed characteristics (Peel et al.

2010). In the past, the quality of cattle exchanged between two countries was different; the United States exported high-quality specimen to Mexico and imported young cattle (Lopes and Riguzzi 2012). However, economical and regional integration led to a significant improvement in genetics and breeding techniques in Mexico which is expected to lead the beef production in Mexico to increase. Then the exported quantity of feeder cattle to the United States might decrease over time. Therefore, the dynamics of specialization of cattle production will likely change in the future.

With the foundation of the cattle industry, a number of recent studies identified that local violence in Mexico and the continuation of safety concerns negatively impact the bilateral trade. To some extent, the decrease in the exports of feeder calves to the United States can be due to violence at the border, which has constrained USDA inspection personnel's ability to conduct import inspections (Juan and Williams 2010). According to the Federal Bureau of Investigation (FBI)'s Stats and Services, among the ten ports of entry the top three cities with the highest violent crimes occurred in the regions close to Santa Teresa, NM, Columbus, NM, and Laredo, TX from 2009 to 2013 shown in Figure 2.

**Figure 2. Annual Violent Crime by City**




Source: FBI, Stats and Services 2014

Due to limited availability of sources, not every port of entry's city had the crime value for each year. So whenever the value was not present this graph used the nearest city's average violent crime values. For example, Santa Teresa, NM and Columbus, NM did not have crime values so El Paso, TX's value was used to generate the graph since they are located very close together.

As it was mentioned above, the USDA veterinarians are responsible for cattle inspections before cattle cross the border. However, the crimes caused by drug cartels in Mexico has moved its operations to the United States and they forced the USDA to close down the port of entries and to establish temporary facilities, which will protect the safety of the US inspectors and maintain the flow of trade across the US border with Mexico. For example, in March 2012, gang violence caused the closing of U.S. cattle inspection stations in Reynosa, Tamaulipas across from Hidalgo, Texas and Nuevo Laredo, Tamaulipas across from Laredo, Texas for six weeks and this closure was estimated to affect 11 percent of cattle being offered for entry into the United States (Texas Department of Agriculture 2010). Furthermore, due to repeated security concerns and local violence, the facility in Ojinaga, Chihuahua across Presidio, Texas was closed in August 2012; and it was not reopened until June 23, 2014 (Brezosky 2014). During the closure, a temporary USDA facility in Presidio was opened on October 2, 2012 until the actual port was reopened (Matheis, Garcia, and Halpern 2012). According to Brezosky (2014), Mexican cities across from Del Rio and Eagle Pass facilities were also closed due to violence since 2010. These events forced Mexican ranchers to transport their animals to the other ports of entry and it further decreased the exports of feeder cattle to the United States.

When the USDA withdraws its cattle inspectors from Mexico to protect them from violence throughout the ten major ports of entries across three states – Arizona, New Mexico, and Texas – the international trade is impeded (see Figure 3). If one port of entry closes, cattle producers have to travel further distances and cattle might lose weight in the process. Furthermore, the local economies are also affected by this change, including businesses like feed stores and transportation services.

**Figure 3. Map of U.S.-Mexico Border Regions**


Source: USDA, ERS 2014

The qualitative analysis determined that given the seasonal variations, inspections process, policy and technology changes, and cattle genetic improvements, some factors will have positive impacts on trades like droughts or decrease in rainfall in Chihuahua and increases in the U.S. prices. On the other hand, other factors such as violence at the ports of entries and presence of diseases might discourage live cattle imports from Mexico.

# 3. LITERATURE REVIEW

A brief review of the literature provides background and different perspectives of the study illustrating the wide range of methods that are relevant to the related studies. Having a firm foundation and background on the cattle industry, understanding the application is important for those involved in the international trade business as it will aid them examining bilateral trade flow determinants.

## 3.1 Cattle Crossing Models at Each Port of Entry

Many studies attempted to identify the factors affecting the supply of Mexican feeder cattle to the U.S. cattle market. Mitchell (2000) analyzed U.S.-Mexico cattle trade at each port of entry using simple regression model. With limited resources, Mitchell provided the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) with a study of the factors that influence feeder cattle movements from Mexico into the United States. Although Mitchell did not considered the violence factors, the work of analyzing the relationship between the ports of entry along the border aided the USDA APHIS in addressing questions related to feeder cattle movements between the two countries. Mitchell (2000) estimated separate simple regression models for nine live cattle ports of entry (Columbus, Del Rio, Douglas, Eagle Pass, Santa Teresa, Laredo, Nogales, Presidio, and San Luis) along the U.S.-Mexico border; monthly numbers of live cattle imported at each port as the dependent variable. Using an ordinary least squares (OLS) method, the final models were selected based on economic theory, t-statistics, and $R^2$ (Mitchell 2000). Even with the limited availability of Mexican data, Mitchell found statistically significant rainfall effects and their variability in the rainfall coefficient signs, and significant trend variable in the models. The study provided valuable information and examples predicting the live cattle imports from Mexico into the United States by port of entry.

A few years later, this work was revisited when additional data were obtained and was reported by Guinn (2005). Guinn (2005) updated and re-estimated simple regression models developed by Mitchell (2000) using step-wise regression procedures with statistical significance set at $\alpha$=0.10 to evaluate the monthly dummy variables and trend variables. With some monthly variables statistically significant for different models, Guinn (2005) found the trend variable to be significant in only two of the nine models, Eagle Pass and Laredo. Furthermore, Guinn (2005) evaluated nine regression models that represent the cattle crossings at each port of entry and concluded that the single equation regression models explained at least 54% if the variability in monthly cattle crossings at each port of entry which are slightly weaker than the explanatory powers of Mitchell's models. Guinn concluded that the greater U.S. cattle prices, the greater number of cattle imported from Mexico; and during periods of drought, the cattle exports to the United States increased (Guinn 2005). Acknowledging the existence of additional variables that should be incorporated into the port-of-entry explanatory models, the study overall provides insight on some variables affecting the numbers of cattle being traded between two countries.

### 3.2 Related Research

There has been more research reported on international trade flows. Adewuyi and Akpokodje (2010) adopted the econometric approach in estimating the effect of trade liberalization on trade flows in Nigeria employing the OLS and the generalized method of moments (GMM) techniques. Using a dummy variable, their econometric results implied that all categories of imports experience improved performance during a trade liberalization period compared to the pre-liberalization period (Adewuyi and Akpokodje 2010). Using the two different techniques, their econometric results reveal that foreign income has a significant positive effect on exports of all categories; the real (effective) exchange rate has a significant positive effect on agricultural exports and non-oil exports but an insignificant effect on manufactured exports (Adewuyi and Akpokodje 2010). For the purpose of the paper, the study does not go further into the comparison of the two different estimation techniques or how improvements can be made to produce better test results.

Given the limitations of OLS introducing bias in the regression estimates of the values of the coefficients and their standard errors, a simultaneous equations model Seemingly Unrelated Regression (SUR) estimation proposed by Zellner (1962) can be used. Using a simultaneous equations framework, Xu (2000) employed a SUR estimation technique to estimate a system of sectoral share equations derived from the generalized GDP function and found that technology is a significant determinant of the international competitiveness of environmentally sensitive industries. The SUR method to account for the correlations between the residuals in the equations was also used to measure the prices for wastewater services across regions and localities (Bae, Gen, and Moon 2011). Bae, Gen, and Moon (2011) employed the demand and price equations for wastewater services using SUR and concluded that price differences of wastewater services are depended on the institutional arrangements of wastewater utilities, government regulations at the sate and local level, supply factors and characteristics, however, not so much on natural environmental and local characteristics. Also, other social scientists like Johns et al. (2013) used a SUR approach to determine if primary health care facilities in remote areas have fewer outpatient visits than other rural facilities and their results indicated that remote facilities have about 13% fewer outpatient visits than non-remote facilities.

Golub and Hsieh (2000) revisited the classical Ricardian model using cross-section seemingly unrelated regressions of sectoral trade flows. They tested the pairs of countries vis-à-vis the United States using three different purchasing power parity exchange rates to determine trade pattern. In their studies, they found that the errors in the annual cross-section regression are likely to be highly correlated across years since trade patterns change slowly over time (Golub and Hsieh 2000). Therefore, they used SUR equations to support the Ricardian model. Golub and Hsieh (2000) found that when the equations were estimated with OLS, the signs and magnitudes of coefficients were similar to those found with SUR, but the t-statistics were always smaller with a few exceptions. On the other hand, the standard errors of the SUR regressions decrease with the number of years used, thereby increasing the t-statistics in the end. Thus, they concluded that the SUR regressions yielded more precise estimates in most cases because they make use of more information by estimating the cross-section regressions over several years simultaneously (Golub and Hsieh 2000). With their limited data availabilities and difficulties involved in making the requisite international comparison of productivity and labor compensation, Golub and Hsieh (2000) study provides strong support for the Ricardian model.

Chionis, Liargovas, and Zanias (2002) expanded the Zellner's SUR estimating the coefficients of the gravity model in order to determine the magnitude of potential trade flows between Greek and nine Balkan countries. The highlight of their research is allowing for correlation between the error terms; the errors of Greece-Germany may be related with the errors of Greece-France (Chionis, Liargovas, and Zanias 2002). Furthermore, they found the SUR estimation was effective in finding potential trades between Greece and the Balkans. Overall, the OLS and the SUR estimations have been widely used to research international and regional integration trade patterns.

It has been recognized that there are many factors that affect international trade flows. Overall, in order to develop an understanding of trade flows, agricultural economists have used ordinary least squares (OLS) and seemingly unrelated regression (SUR), among other econometric techniques, as it will aid them examining bilateral trade flow determinants.

# 4. METHODS

The impact of border violence that influences the bilateral cattle trade can be expressed conceptually. The literature described in the previous chapter serves as a building block to quantify how the volumes of cattle crossing into the United States through each port has been affected by specific factors. Thus, with border closures in one port of entry due to security concerns will affect the volume of Mexican feeder cattle exports into the United States, therefore, international trade.

## 4.1 Gravity Model

Some international trade economists used the gravity model of trade to research international and regional integration trade patterns. The trade flow between two countries has a positive correlation with economic size and has a significant negative correlation with the geographical distance between the two countries (Cheng et al. 2012). In other words, farther the distance between the two countries will negatively affect the bilateral trade flows. The gravity equation has been used to measure trade frictions and geographic characteristics on bilateral trade. Even though the gravity equation measure the impact of trade barriers on bilateral trade flows, the equation needs the estimates of geographic distance and GDPs of each country. Therefore, the gravity model was not appropriate since the study is an effort to determine the cattle flow at each port of entry along the U.S.-Mexico border.

### 4.2 Conceptual Models

Econometric regression techniques can be used to statistically measure the contribution of multiple variables in determining the volume of cattle inflows for each individual port, including the impacts of border closures. The ordinary least squares (OLS) procedure and seemingly unrelated regressions (SUR) estimations are commonly used to quantify the effects of border closures on the overall historical data allowing the economists to statistically measure the contribution of multiple variables as they aid the analyst to capture the specific port of entry attributes of international cattle trade.

To test economic theories and evaluate policy effects such as border closures due to violence, OLS is selected for estimating the parameters of a multiple linear regression model and its estimates are obtained by minimizing the sum of squared residuals (Wooldridge 2013). Since the key assumption for the general multiple regression model requires that all factors in the unobserved error term to be uncorrelated with the explanatory variables, any problem that causes the error term to be correlated with any of the independent variables cause the assumption to fail (Wooldridge 2013). Therefore, the least squares estimator should not be used to estimate an equation in a simultaneous equation model.

To improve the precision of the dummy variable model estimates, the study uses a simultaneous model called SUR. It estimates multiple equations jointly, accounting for the fact that the variances of the error terms are different for the two equations and accounting for the contemporaneous correlation between the errors of the different equations (Hill, Griffiths, and Lim 2011). It is expected that the dependent variable be related given that the number of cattle crossings are linked across regions in integrated markets, therefore, combining the data from the ten ports brings gains to our analysis.

Allowing many observed factors to affect the dependent variable (regressand) $y_t$, the general multiple line *yt* regression model can be written in the population as

$$y_t = X_t\beta + \mu_t, t = 1,2,\ldots,N$$

where a sum of a linear function of the K observable explanatory variables (regressors) $X_{kt}$, k = 1,2,…K, and an unobservable error term $\mu_t$ (Hwang 2013). The subscript t indicates the t$^{th}$ observation, $X_t$ is a K-dimensional row vector and $\beta$ is a K-dimensional column vector of unknown coefficients. This is written in a matrix form for the entire N observations as

$$y = X\beta + \mu$$

where the dimensions of the matrices are $y$=Nx1, X:NxK, $\beta$:Kx1, and $\mu$:Nx1 (Hwang 2013). There are several assumptions of non-stochastic regressors X: 1) The columns of X (observation vector of each regressor) are linearly independent and the number of observations N is greater than or equal to K, 2) all error terms have the same expected value and the value is zero, E (μ) = 0, 3) the error terms have the same variance and uncorrelated with each other, and 4) y is distributed as a multivariate normal N (X$\beta$, $\sigma^2 I$) (Hwang 2013). Therefore, any problem that causes μ to be correlated with any of the independent variables causes the assumption to fail (Wooldridge 2013).

Many studies present the different computational and algebraic features of the method of ordinary least squares. The method of ordinary least squares is popularly used for estimating the parameters of the multiple regression model (Wooldridge 2013). The estimated OLS equation is written as:

$$\widehat{y_t} = X_t\hat{\beta}$$

where the predicted value of $y_t$ is $\widehat{y_t}$ and $\beta$'s estimator is $\hat{\beta}$ (Hwang 2013). According to Hwang and Wooldridge, the method of ordinary least squares chooses the estimates to minimize the sum of squared residuals.

$$\hat{\mu}_t = y_t - \hat{y}_t$$

is called the prediction error or residual. Given observations, the estimates $\hat{\beta}$ are chosen simultaneously to make sum of residuals as small as possible (Wooldridge 2013). The least squares method of estimation of unknown coefficients finds the vector $\hat{\beta}$ that minimizes the sum of squared residuals (SSR)

$$\min SSR \sum_{t=1}^{N} (y_t - X_t\hat{\beta})^2 = (y - X\hat{\beta})'(y - X\hat{\beta})$$

Then taking derivatives of the SSR with respect to $\beta$, we find the first and the second order conditions

$$\frac{dSSR}{d\,\hat{\beta}} == -2X'y + 2X'X\hat{\beta} = 0 \text{ and } \frac{d^2\,SSR}{d\,\hat{\beta}\,d\,\hat{\beta}\prime} = 2X'X > 0$$

The OLS estimator of $\beta$ is the solution of the first order condition $X'X\hat{\beta} = X'y$ (Hwang 2013). The OLS predictor of the dependent variable is defined as $\hat{y} = X\hat{\beta}$ and $\hat{\mu}_t = y - X\hat{\beta} = y - \hat{y}$ is the vector of residuals. Since X is non-stochastic and X and μ are not correlated,

$$cov(X_t, \mu_s) = 0$$

for all t and s (Hwang 2013).

Then a t-statistic is used. The calculated t-value is compared to the critical t-value to determine if a variable is considered significant. If the calculated t-value is greater than the critical t-value then the variable is considered to be significant. For this research, the significance level of $\alpha = 0.05$ were chosen to determine the critical value.

Also, the goodness of fit is another important aspect to decide the acceptability of the model. The multiple correlation coefficient, $R^2$, measures the strength of the relationship between the dependent variable and the independent variables jointly. The fit of the model is said to be better if $R^2$ is closer to 1 (Wooldridge 2013). However, when there are many predictors and a small sample, the adjusted $R^2$ is reported because it removes the part of $R^2$ that would be expected just by chance (Acock 2012). Acock recommends to report both values.

Correlation measures how close the observations are to the regression line using a correlation coefficient, r. (Acock 2012). If r is higher the observations are closer to the regression line and if r is positive the regression line goes up. In other words, correlation measures the strength of the relationship for how close the dots are to the regression line (Acock 2012). It is important to note that when we estimate a correlation, we also need to report its statistical significance level. The test of statistical significance of a correlation depends on the size of substantive significance of a correlation in the sample and depends on the size of the sample (Acock 2012).

Since many variables that were used in this research were dummy variables, the study uses a seemingly unrelated regression improving the precision of the dummy variable model estimates. It estimates multiple equations jointly, accounting for the fact that the variances of the error terms are different for the two equations and accounting for the contemporaneous correlation between the errors of the different equations (Hill, Griffiths, and Lim 2011). The model consists of j=1…m linear regression equations for i=1…N individuals. The $j^{th}$ equation for individual i is

$$y_{ij} = X_{ij}\beta_j + \mu_{ij}$$

and when all observations are stacked, the SUR model for the $j^{th}$ equation can be written as

$$y_j = X_j\beta_j + \mu_j$$

where $y_j$ is a Nx1 vector of dependent variable, and $X_j$ is a $NxK_j$ matrix of exogenous variables. And the error term $\mu_j$ have the moments E($\mu_j$) = 0, and E($\mu_j\mu_k'$) $=$ $\sigma_{jk}I$ (Hwang 2013). According to Hill, Griffiths, and Lim, there are three stages in the SUR estimation procedure: 1) estimate the equations separately using least squares since the model share some of the same exogenous variables that are likely correlated, 2) use the least squares residuals from step (1) to estimate variances and covariance, 3) use the estimates from step (2) to estimate the two equations jointly within a generalized least squares framework (Hill, Griffiths, and Lim 2011). Overall, this three steps process improve the efficiency of the estimators when the equations are only related through the error term and this study will use Stata software including commands for SUR that automatically perform all three steps.

### 4.3 Econometric Models

Based on previous related research and the qualitative analysis of the United States and Mexican cattle industries in the previous chapter, ten econometric models will be tested in Chapter 5 to explain the effect of the border closures on the cattle crossings through different ports of entry along the U.S.-Mexican border.

1) Mexican Feeder Cattle Imports from Santa Teresa;
2) Mexican Feeder Cattle Imports from Nogales;
3) Mexican Feeder Cattle Imports from Laredo
4) Mexican Feeder Cattle Imports from Eagle Pass;
5) Mexican Feeder Cattle Imports from Hidalgo;
6) Mexican Feeder Cattle Imports from Douglas;
7) Mexican Feeder Cattle Imports from Columbus;
8) Mexican Feeder Cattle Imports from Del Rio;
9) Mexican Feeder Cattle Imports from Presidio;
10) Mexican Feeder Cattle Imports from San Luis.

Based on review of past literature and the data available, OLS procedures were first selected for analyzing live cattle imports from Mexico into the United States concerning the impacts of border closures at each port of entry. Each of the ten ports had their own unique model to represent their own phenomenon from January 2009 to September 2014. The dependent variable in each model was total monthly cattle crossings through the selected port of entry; the explanatory variables used in the initial model development and testing were lagged cattle imports; port of entry closures;

temporary facility openings; drought; corn price; US feeder steers price; US fed steers price; Mexico feeder steer price; exchange rates; oil price; seasonality; linear trend; and parabolic trend (see Table 1). For example, Santa Teresa port of entry will be measured as:

SantaTeresa = $f$ (STlag, Nogales, Laredo, EaglePass, Hildago, Douglas, DelRio, Columbus, Presidio, Plag, SanLuis, Pdummy, Tdummy, Drought, Corn, Usfeeder, Usfed, Mxfeeder, Exchrate, Oil, Trend, Trend2, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov)

Then the other port equations will be modeled using the same explanatory variables except that one explanatory port (independent variable) becomes the explained port (dependent variable) for the next equation. For example, after Santa Teresa modeling, the explained variable SantaTeresa will become the explanatory variable for the other equations; Nogales will become the explained variable for its equations and will be the explanatory variable for the other equations.

Secondly, models are jointly estimated using the SUR estimator because they are conceptually related. The SUR model is a system of linear equations with error terms that are correlated across equations for a given port of entry. It is hypothesized that the geographical locations of the ports are conceptually related equations; therefore, this study recognizes that there is a potential for correlation between the error terms of the two equations. If the error terms are correlated, the SUR model is an appropriate technique for addressing cross-equation error correlation, and will gain efficiency by using the SUR model. However, if the error terms of these ten models are unrelated, then the OLS regressions will be sufficient.

With the conceptual model in place, the next chapter focuses on the discussion of the data used for this analysis.

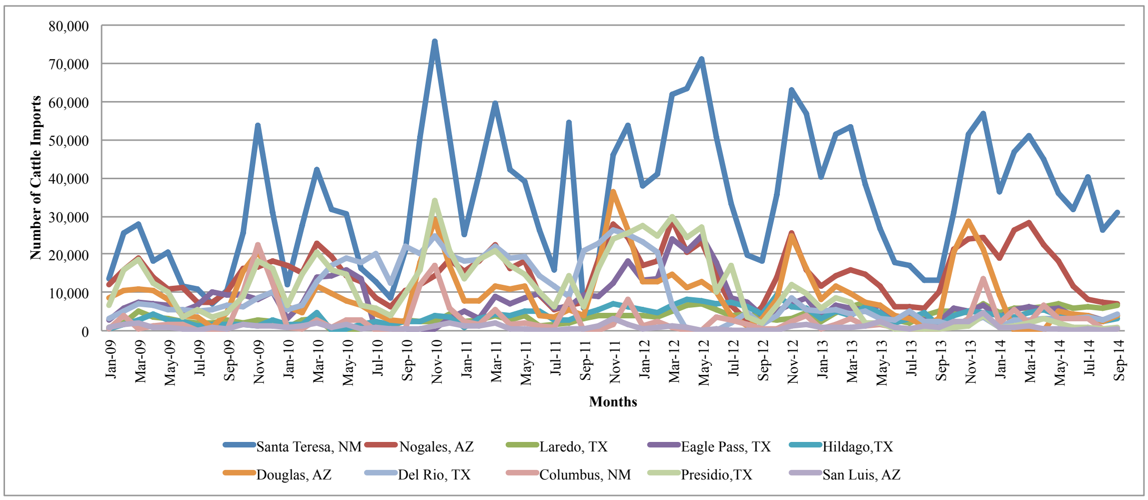
**4.4 Review of Data**

This section takes an in-depth look at each variable used in this analysis. Monthly data used in this research were from January 2009 to September 2014 were collected from the World Institute for Strategic Economic Research (WISERTrade), the United States Department of Agriculture Foreign Agricultural Service's Global Agricultural Trade System (USDA FAS GATS), and Livestock Marketing Information Center (LMIC).

The monthly US cattle imports in dollar value from Mexico's port of entry data were first extracted from WISERTrade. These values were divided by the ratios of the monthly US cattle imports from Mexico's overall import dollar values and total quantities. So monthly US cattle net quantity imports by port of entry were generated. The study attempts to measure the impact of a closed port of entry on the nearby port of entries through the use of a regression in Stata software, a series of economic explanatory variables, and a dummy variable for port of entry openings and closure.

Figure 4 shows monthly cattle crossings from January 2009 to September 2014 into the United States for each of the ten ports of entry. There were some fluctuations in cattle flows throughout the year; a seasonal pattern in the US cattle imports from Mexico is present. The general trend is that all ports of entry have higher imports from Fall to Winter months and fewer imports in Summer months.

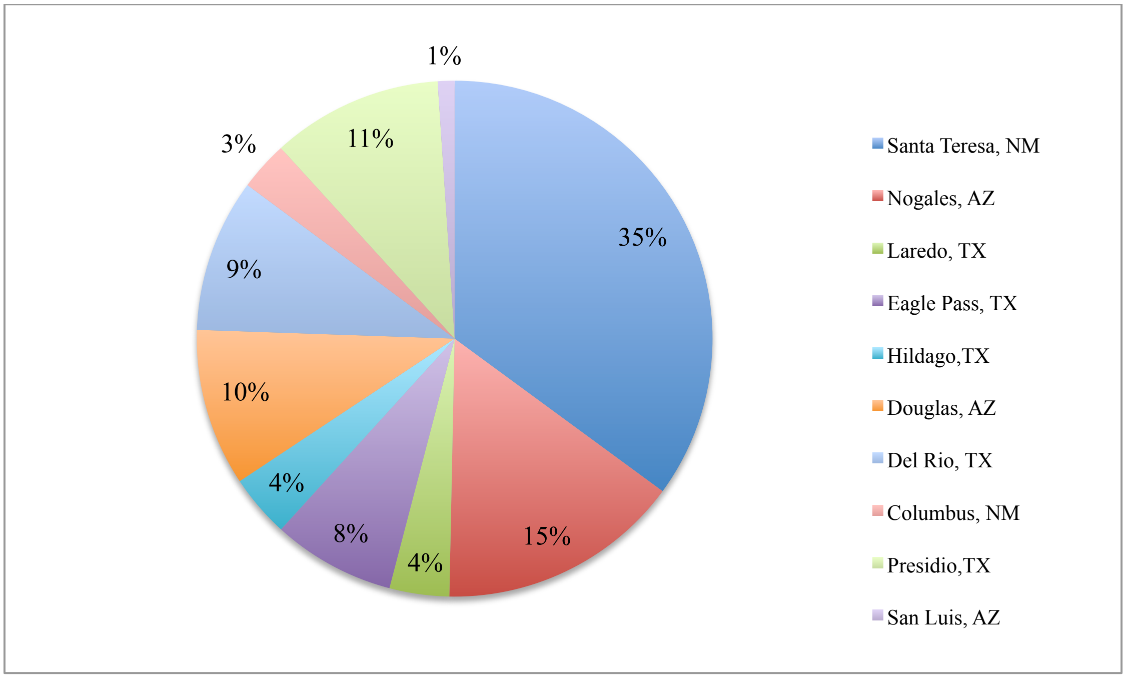
**Figure 4. Monthly Cattle Imports from Mexico by Port of Entry from January 2009 to September 2014**




Source: WiserTrade 2015

Figure 5 gives another representation of the monthly percentages of cattle imports for all ports. Of all the cattle that crossed from Mexico into the United States through the ten ports of entry, Santa Teresa had the largest volume of cattle entries at 35%. Nogales was the second largest port of entry for cattle imports at 15%, and Presidio was the third largest port of entry at 11%. Relatively few cattle came through the ports in Columbus, New Mexico, San Luis, Arizona, Hidalgo, Texas, and Laredo, Texas. Columbus had 3%, San Luis had 1%, Hidalgo had 4% and Laredo had 4%.

**Figure 5. U.S. Cattle Imports from Mexico by Port of Entry from January 2009 to September 2014**




Source: WiserTrade 2015

Careful comparisons between the port of entry data provided implications of a significant relationship between the port variables. As discussed earlier, as one port's cattle crossings increase, a nearby close port's cattle crossings would be positively or negatively impacted. Therefore, the distance between the ports may impact the number of cattle crossings at each port of entry.

Many literatures have indicated that the cattle trade faced the anomaly of a severe drought in 2010 and 2011 that forced Mexican cattle ranchers to liquidate their herds earlier than normal. These similar patterns were presented at each of the ten ports of entry, so Texas's drought data were collected from the United States Drought Monitor to examine their influences. Those data provide weekly drought measures of extreme and exceptional drought percentages and were averaged into a monthly account.

Since corn is a major input to the production of feeder cattle, the average prices of corn (dollars per bushel) received by farmers were used in the models. For example, the drought in the U.S.-Mexico border region causes the corn prices to increase due to lower supply of corn; this change in rainfall will negatively impact the cattle producers. The feeder cattle producers in Mexico will want to reduce their herd while the feeder cattle producers in the United States will want to buy fewer cattle. When the demand of Mexican feeder cattle decreases and the supply of Mexican cattle increases in the United States, the Mexican feeder cattle will face lower price as a result of the drought. Therefore, the direction of the cattle inflows will be impacted by the corn price changes and drought measures. Prices for corn were collected from the Economic Research Service (ERS) of the USDA National Agricultural Statistics Service over January 2009 to September 2014 period.

In addition to corn prices, other prices like U.S. feeder steers and U.S. fed cattle steers were extracted from the LMIC. The prices for Mexican feeder steers from USDA Agricultural Marketing Service (USDA AMS) were also included in the calculations since Mexican cattle exports are depended on both U.S. and Mexican prices. For instance, like it was discussed relatively higher US feeder cattle prices will increase the exports of Mexican feeder cattle which will results in a positive sign on the US cattle price coefficient.

Lastly, crude oil (petroleum) price (dollars per barrel) was used to capture some distance impacts that we were unable to capture using the gravity model. The longer the distance that trucks have to travel, the higher the oil, labor, and other associated risks costs.

Other variables to discuss in the model were a linear and parabolic trend. Linear trend (X) and parabolic trend ($X^2$) measure the upward or downward movements, and lagged variable for number of cattle crossings to capture dynamic changes based on the past values.

In addition, many of the variables that were used in this research were dummy variables representing the seasonal pattern in U.S. cattle imports from Mexico. Dummy variables usually take two values, one or zero, to indicate the presence or absence of a characteristic or to indicate whether a condition is true or false (Hill, Griffiths, and Lim 2011). In this study, the twelve monthly dummy variables were zero or one depending on the month of the year to consider the seasonal fluctuations; eleven dummy variables represent the 12 months of the year (December as a reference month).

Most importantly, the border violence was represented using dummy variables called Pdummy representing the closure of the Presidio port of entry and Tdummy representing opening of the temporary facility. The study defines the first indicator variable $D = 1$ if port of entry was closed due to violence and $D = 0$ if port of entry was opened. For temporary facility that were opened after 2 months of absolute closure, the study defines second indicator variable $D = 1$ for absolute port closure and $D = 0$ for the opening of temporary facility.

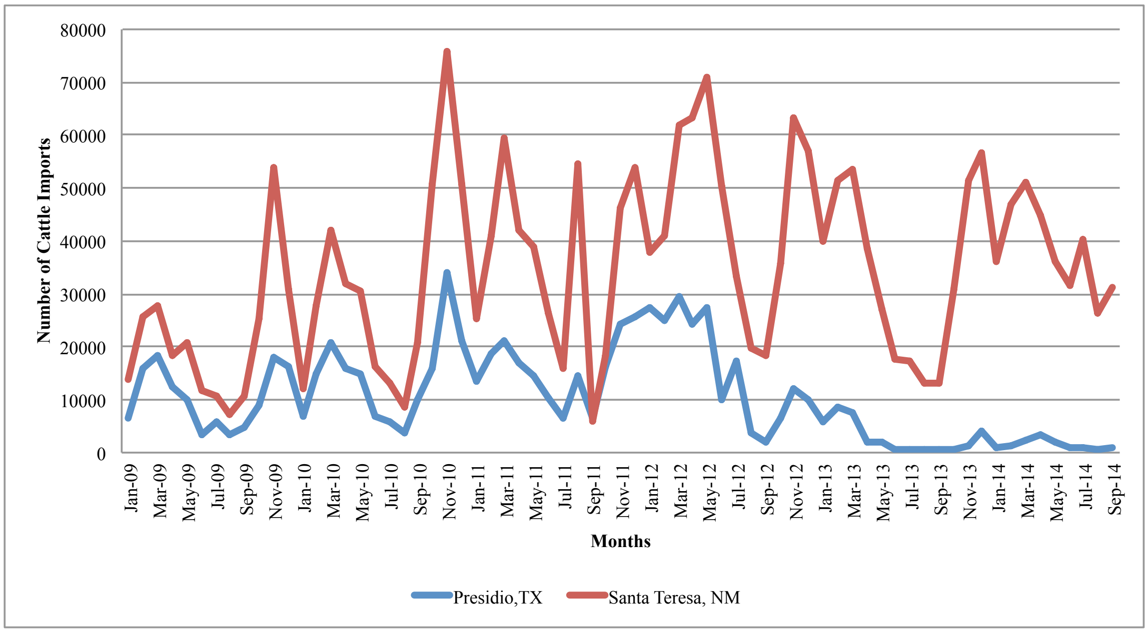
# 5. MODELS, ANALYSIS, AND RESULTS

In this chapter, regression results identify the effects of border violence that have a great influence on the movement of feeder cattle across U.S. and Mexican borders. Referring back to the previous literatures, currently, the Santa Teresa, NM cattle crossing facility handles the largest volume of Mexican animals entering the United States (about 454,288 head in 2012) (USDA AMS 2014). However, it is also a city surrounded by one of the highest violence incidents. Thus, if its border nearby closes down due to violence, its impact is expected to be large.

## 5.1 The Presidio and Santa Teresa Ports of Entry

The first objective is achieved using the OLS regression to test for statistical significance of cattle inflows between the Presidio port of entry and the Santa Teresa port of entry and if closure causes the diversion of the cattle imports from Mexico. The Presidio, Texas port of entry is across from Ojinaga, Chihuahua and is about 241 miles away from the Santa Teresa, NM port of entry. The Presidio port of entry was closed for 22 months from August 2012 to June 2014 due to repeated security concerns including local violence (Brezosky 2014). Given limited data, within the 22 months period of closure the temporary facility was opened for 20 months. This implies that the Presidio port of entry had 2 months of no inflows from August 2012 to September 2012. However, the imported data from WiserTrade are determined by port of unlading, therefore the numbers for the two periods period of the absolute border closures were given values. In other words, for those two periods the cattle were first transported to the Presidio port of entry and were unloaded, however, they were imported from the other ports of entry (see Figure 6).

**Figure 6. Monthly Cattle Imports at the Presidio and Santa Teresa Ports of Entry**




Source: WiserTrade 2015

Looking at the graph, the two ports are moving together in 2009 and 2011. After May 2012, there was a decreasing trend of cattle inflows through two ports of entry and in August 2012 during the port closure, they faced the extremely low volumes of cattle inflows. There is a possibility that the decreasing trend that started from May 2012 was caused by the violence in the region. Then the inflow was stabilized in October 2012 when the temporary facilities were established. The variables that this analysis will consider include all ports of entry data (specifically ports of unladed data), lagged data, prices of corn, U.S. feeder steer, U.S. fed steer, Mexican feeder steers, Texas drought measures, trends, and dummy variables to represent the border closures and the availabilities of temporary facilities before and after violence.

The OLS results of the estimated port of entry equations are reported in Table 2. It can be seen from the table that border closing at the Presidio port of entry had a statistically positive effect on exports through the Santa Teresa port of entry. It's important to notice that using a temporary facility opened at the Presidio port of entry does not make our results statistically significant. Other ports of entry that are within a 200~ 250 miles range from Santa Teresa, NM; also see larger crossings due to border closure, including Douglas (204.7 miles), Columbus (59.7 miles), and Presidio (241 miles). For instance, Columbus, Douglas, Presidio and Santa Teresa ports of entry exhibit a positive relationship, and other ports of entry that are outside of the range are not statistically significant. On the other hand, Del Rio (447 miles) and Santa Teresa ports of entry exhibit a negative relationship, or may be substitutes of each other.

From the OLS results, if the Presidio port of entry is closed due to violence, then an average of 16,212 more cattle per month cross the Santa Teresa port of entry, which can be shown in Table 2. In consideration of natural trade frictions, such as distances between two ports of entry of 200~250 miles, range plays a significant role in our OLS model. The Santa Teresa port of entry is positively related to the ports that are within 200~ 250 miles range.

## 5.2 Correlations between Ports of Entry

Keeping geographical references using Stata software, all estimations were performed with 68 observations from January 2009 to September 2014. The correlation table is provided in Table 3.

Acknowledging the small sample size and with statistical significance level of $\alpha = 0.05$, the highest r value of 0.6412 between variables SantaTeresa and Nogales indicates that these two ports of entry are strongly related. Having high number of Mexican feeder cattle imported through the Santa Teresa port of entry probably leads to high number of Mexican feeder cattle being imported through Nogales port of entry. The dummy variable Pdummy is coded with a 0 for opening and 1 for the closure. Using a dummy variable, "the stronger the correlation is, the greater impact the dummy variable has on the outcome variable" (Acock 2012). The last row of the correlation matrix shows the correlation between Pdummy and each port of entry. The $r = 0.1033$ between Pdummy and Santa Teresa port of entry means that when Presidio port of entry was closed (coded 1 on closure), a higher number of feeder cattle were being imported through Santa Teresa port of entry than when it was open (coded 0 on Pdummy), and this is almost a moderate relationship. The $r = -0.5192$ between Pdummy and DelRio means that the Presidio port of entry closure lowers the number of feeder cattle crossings in Del Rio port of entry than when it was opened. Table 3 displays correlations between ports of entry and suggests which ports are positively and negatively correlated.

### 5.3 The OLS and SUR Results

Using Stata software, the estimated parameters from the OLS output in Table 4 and the SUR output in Table 5 are compared. For OLS, the single equation regression models explained at least 76.90% ($R^2$) and 54.47% (adjusted $R^2$) of the variability in monthly cattle crossings at each port of entry. In consideration of their significance using p-values, the signs of the prices for corn, U.S. feeder steers, U.S. fed steers, Mexican feeder steers, exchange rates, oils, droughts, and trends were mixed. Price of corn was significant in Nogales and Del Rio; price for U.S. feeder steers was significant in Hidalgo; price for U.S. fed steers was significant in Presidio and Del Rio; price for Mexican feeder steers was significant in Columbus; exchange rate was significant in Presidio and Nogales; price of oil was significant in Nogales; drought was significant in no ports; Trend2 was significant in Columbus, Eagle Pass and Santa Teresa; Pdummy was significant in Santa Teresa and Presidio; and Tdummy was significant in Del Rio. Lastly, the Laredo model had no statistically significant variables and the Hidalgo and San Luis model had very few statistically significant variables.

Given correlation between ports of entry, the OLS results to SUR results are compared in Table 6. For instance, using OLS Santa Teresa, New Mexico port of entry model is specified as:

$$\widehat{SantaTeresa} = 0.955\, Douglas - 0.766\, DelRio + 1.417\, Columbus + 1.038\, Presidio + 16212.263\, Pdummy - 22.871\, Trend2$$

$$(R^2 = 0.9398, Adj.R^2 = 0.8814)$$

And using SUR Santa Teresa, New Mexico port of entry model is specified as:

$$
\begin{aligned}
\widehat{SantaTeresa} = {} & 1.379\ Nogales + 2.097\ Laredo - 0.690\ EaglePass \\
& + 1.492\ Douglas - 1.211\ DelRio + 1.819\ Columbus \\
& + 1.358\ Presidio - 3.980\ SanLuis + 23703.226\ Pdummy \\
& - 15472.089\ Tdummy + 1138.397\ USfed - 8442.771\ exchrate \\
& - 485.487\ oil + 8935.731\ Jan + 11317.751\ Feb + 9559.456\ Apr \\
& + 15839.098\ May + 30550.801\ Jun + 31029.297\ Jul \\
& + 32656.389\ Aug + 26271.796\ Sep - 11438.900\ Nov \\
& - 29.773\ Trend2
\end{aligned}
$$

$$(R^2 = 0.9185)$$

The SUR models explained at least 74.62% of the variability in monthly cattle crossings at each port of entry. According to Table 5, price of corn was significant Nogales, Eagle Pass, Hidalgo, and Del Rio; price for U.S. feeder steers was significant in Nogales, Eagle Pass, Hidalgo, Del Rio, Presidio, and San Luis; price for U.S. fed steers was significant in Santa Teresa, Laredo, Hidalgo, Del Rio, and Presidio; price for Mexican feeder steers was significant in Hidalgo, Douglas, Columbus, and Presidio; drought was significant in Laredo and Eagle Pass; Pdummy was significant in Santa Teresa, Laredo, Douglas, Del Rio, Columbus, and Presidio; and Tdummy was significant in Santa Teresa, Del Rio, and Columbus. Compared to the OLS results, SUR was able to capture more statistically significant variables (see Table 6).

Because the data has a relatively small number of observations being predicted with a relatively large number of variables, both $R^2$ and the adjusted $R^2$ are reported for OLS equations. Acock (2012) argues that with a small sample with several predictors, the value of coefficient of determination ($R^2$) can exaggerate the strength of the relationship and a big $R^2$ can result just by chance; on the other hand, the adjusted $R^2$ removes the part of $R^2$ that would be expected just by chance (Acock 2012). Keeping this in mind, only $R^2$ is reported for SUR because the SUR estimation procedure is optimal under the contemporaneous correlation assumption, so no standard error adjustment is necessary (Hill, Griffiths, and Lim 2011).

Overall, the $R^2$ values from OLS were greater than the $R^2$ values from SUR. However, when the adjusted $R^2$ values from OLS were compared with the $R^2$ values from SUR, higher $R^2$ values from SUR were observed.

With SUR, the study found smaller standard errors for all equations compared to OLS (see Table 6). The standard error of the regression is an estimator of the standard deviation of the error term; thus, SUR gives better estimates of the variable parameters than the OLS results, and it has increased the efficiency of the statistical results.

More differences in the number of statistically significant variables between the OLS and SUR techniques are observed in Table 6. When SUR is used, the model provided more significant values. If the coefficients of their test statistics are not significant, this could imply that the problems are not serious. OLS left out significant variables and this could be problematic if the model cannot capture important effects. Therefore, SUR is a better estimation.

Similar to the OLS results, SUR showed border closing at the Presidio port of entry had a statistically positive effect on exports through the Santa Teresa port of entry. Given the Presidio port closure, the Santa Teresa port of entry exhibited a positive relationship with Nogales, Laredo, Douglas, Columbus, and Presidio and a negative relationship with Eagle Pass, Del Rio, and San Luis. The OLS estimations had four port variables and the SUR estimations had eight port variables explaining the independent variable Santa Teresa. For different ports of entry, the same logical process can be used to determine each model.

Examining the Presidio port closure effects, the OLS and SUR estimations gave two different results. The OLS results reveal that two affected ports were Presidio and Santa Teresa (see Table 4). In contrast, the SUR results reveal that the impact of the Presidio port of entry closure was significant in all ports of entry except for San Luis, Nogales, Eagle Pass, and Hidalgo, which are the ports near the ends of the U.S. and Mexico border (see Figure 3 and Table 6). When the Presidio port of entry was closed, positively affected ports were Santa Teresa and Del Rio and negatively affected ports were Laredo, Douglas, Columbus, and Presidio. Thus more ports were negatively affected by the Presidio port closure; however, a significantly large number of cattle crossings through the Santa Teresa ports are observed compared to other ports.

The SUR estimation captured the port of entry closure and temporary facility's significance. The Santa Teresa model implies that when the Presidio port of entry is closed, an average of 23,703 more cattle per month were imported through the Santa Teresa port of entry. However, when a temporary facility was opened in Presidio, an average of 15,472 fewer cattle per month were imported through the Santa Teresa port of entry, which is consistent with our a priori expectation.

The results show the significant effect of the temporary facility in the Presidio port. Similar results were shown for the Del Rio and Columbus ports of entry. After allowing correlations between the errors to occur, the SUR results indicated that the effect of the temporary facility in the Presidio port of entry that when the temporary facility was opened, the cattle crossings through the Santa Teresa port of entry was decreased by 1-(15,472/23,703) = 35%. This analysis suggests that the temporary facility in the Presidio port of entry played an important role, possibly mitigating the impact of port closures caused by violence.

However, there are also limitations to SUR estimations. Going back to the Santa Teresa port of entry model, the distance measure was harder to capture using SUR estimations. This is because all ports of entry were statistically significant to the Santa Teresa port of entry except the Hidalgo port of entry, which is about 777.4 miles away from Santa Teresa (see Figure 3 and Table 7). Hidalgo is the farthest port of entry from Santa Teresa to the east. Also, the Del Rio (447 miles), Eagle Pass (505.4 miles) and San Luis (669.7 miles) ports are negatively related even though they are statistically significant. Interestingly, Nogales (318.7 miles), Douglas (204.7 miles), Columbus (59.7), Presidio (241 miles), and Laredo (622.4 miles) are a statistically significant variable with a positive relationship with Santa Teresa. It was hard to make a clear distinction of range of miles to the extent that show how ports were related. Or the study suggests that in most cases the impact of border closure was strong enough—and all of ports are integrated with one other—that one port of entry positively and negatively impacts each other.

Furthermore, using SUR Pdummy was significant in the Santa Teresa, Laredo, Douglas, Del Rio, Columbus, and Presidio ports; Tdummy was significant in the Santa Teresa, Del Rio, and Columbus ports. From the OLS results, Pdummy was significant in the Santa Teresa and Presidio ports; however, Tdummy was significant in the Del Rio port at the p-value $< 0.05$.

Overall, through the use of a regression in Stata software, a series of economic explanatory variables, and a dummy variable for port of entry openings and closure, the study attempts to measure how much impact a closed port of entry has on the nearby ports of entry. The OLS results show how a border closing at Presidio had statically positive effects on the import of Mexican cattle through the Santa Teresa port of entry. This study recognizes the importance of ports that are within 200~250 miles range from Santa Teresa that are both statistically significant and positively related. However, using SUR more or fewer cattle crossings were observed to be independent from distance. More attention given to the opening of temporary facility in Presidio resulted in an opposite sign, which indicates that establishing the temporary facility offsets the effect of port closure. SUR increased efficiency in the estimated model parameters by correcting for error correlations and providing more statistically significant estimates of the variable than the OLS results. Also, the SUR estimations display smaller standard errors with higher $R^2$ compared to adjusted $R^2$ from the OLS estimations. Therefore, OLS provides minor advantages but SUR is better overall.

# 6. SUMMARY AND CONCLUSION

The cattle industry has undergone several changes from January 2009 to September 2014. There are multiple factors that impact cattle trade between the U.S. and Mexico and finding all trade determinants is complex. Changes in the price of corn, oil, and U.S. and Mexican cattle, as well as changes in seasonal patterns, are some of factors affecting the flow of cattle. Considering these factors, the objective of this research was to identify the effect of significant border changes due to violence in the cattle industry and how the diversion of the cattle imports changes. The models developed in this study will assist decision makers creating more effective markets for the two countries.

This study examined the impact of border closures on the movements of feeder cattle trade between the two countries. The significance of this issue is in the idea that the U.S. government is challenged by violence in the northern Mexico areas where the cattle are being imported. The violence in the border region has negatively influenced the cattle trades between the two countries because the USDA issued border closures. Therefore this paper explores the effect of violence-forced livestock border closures on trade flows of livestock between the U.S.-Mexico border through different ports of entry. The focus of this work was mainly to develop viable econometric based models for border closure effect. Thus this research sheds light on the flexibility of the ports of entry securing the Mexican feeder cattle inflows thereby protecting the stable U.S. cattle industry.

Based on the SUR estimation techniques, econometric results reveal that different ports of entry are related to each other; Del Rio, Eagle Pass, San Luis are negatively related while Nogales, Laredo, Douglas, Columbus, Presidio are positively related to the Santa Teresa port, therefore, not necessarily distance dependent. The SUR estimations also show that when the Presidio port of entry was closed, the number of cattle crossing through Santa Teresa and Del Rio increased and Laredo, Douglas, Columbus, and Presidio decreased. Furthermore, the border closing at Presidio had a statistically positive effect on exports through the Santa Teresa port of entry; and the opening of the temporary facility decreased the number of imported cattle through the Santa Teresa port.

In addition, the research presented in this thesis compared the OLS and SUR estimations and shows the clear benefits of using SUR. When equations were first estimated with OLS, the signs and magnitudes of coefficients were similar to those found with SUR. But smaller standard errors with higher $R^2$ (compared to adjusted $R^2$ from OLS) of the SUR regressions were found. Also, more statistically significant variables explained the port of entry models using SUR, therefore, the study concludes that the SUR regressions yields more precise estimates in most cases. This argument is consistent with Golub and Hsieh (2000)'s work.

Using SUR, the effect of temporary facility in the Presidio port of entry and the percent changes of cattle crossings through the Santa Teresa port of entry were captured. However, to find the distance effects on the relationship between ports need further analysis. In addition, the signs on the prices of corn, U.S. feeder cattle, U.S. fed cattle, Mexican feeder cattle are mixed for both OLS and SUR estimations.

**6.1 Limitations of the Study**

Improved econometric analysis of U.S. imports of Mexican feeder cattle is limited by the amount and type of data available. According to Mitchell (2000), there are twelve ports of entry along the United States-Mexican border; however, most cattle are imported through ten major ports of entry. The port of entry data available was limited since there was no hard record of port of entry closure and opening periods for the other ports such as Laredo and Hidalgo. Only rough data records of the port closures and re-openings were found for these two ports of entry. This port information is particularly important because it reflects the incidents of violence along the U.S.-Mexico border and is expected to change the regression results if the information could be found.

Another problem concerning the data set is the definitions of the cattle import data that were retrieved from WiserTrade and USDA. The model can be updated and re-estimated with clearer definitions of port of entry and port of unlading data sets. Port of unlading data reflects the cattle that were unloaded off the trucks but were not inspected nor imported yet. However, the port of entry data reflects the cattle that were inspected and imported into the United States. WiserTrade specifically defines their data as port of unlading and their import values matched the USDA's import values; therefore, the study treated the port of unlading and port of entry the same. However, port of unlading data implies that within the 2 months period of absolute closure the Mexican cattle were first shipped to the Presidio port of entry and were transferred to another port to be exported to the United States. This transfer is another important aspect of the cattle industry that needs further research. If these two definitions are different, it implies that all cattle shipped to certain destinations may be not imported through the same ports of entry.

Another concern regarding the port data is that the ports can be closed for other reasons such as the discovery of diseases. Considering the importance of the inspection process before the crossings, the study recognizes that violence may not be the only factor that can close the port of entry.

Also, to analyze the number of cattle imports at each port of entry a 12-month lag variable can improve our results because the cattle production at time t is from the time period previous to time period t. In other words, the production of feeder cattle in one year appears as a predictor of the production of feeder cattle in the next year.

Furthermore, in addition to the port of entry variables and port dummy variables, other exogenous variables, such as U.S. Cattle and Mexican cattle inventory, Mexican corn prices, and Mexican pasture conditions can be other key factors in determining marketing patterns for Mexican cattle trade. Also, if more years of comprehensive set of data have been available for this research, better estimates of the β's might have been calculated.

### 6.2 Implications

Feeder cattle from Mexico are an important source of cattle for the United States due to geographical proximity. When the USDA withdraws its cattle inspectors from Mexico to protect them from violence throughout the ten major ports of entries across three states – Arizona, New Mexico, and Texas – then international trade is impeded, affecting ranchers and cattle feeders in the United States. Since cattle imported from Mexico tend to be feeder cattle, this research focused on the feeder cattle imports from Mexico that were influenced by the border violence. Given the ten major ports, the ten models presented captured the strong seasonal marketing patterns, and the figures and tables illustrate the distributions of U.S. imports of Mexican feeder cattle by port of entry.

When errors are correlated using the SUR technique, the study finds that the Presidio port closure affected more ports compared to the OLS results, and temporary facility played a significant role in the flow of Mexican cattle into the United States. However, due to the immediate openings of the temporary facilities, the extent the closure causes aggregate decrease in the bilateral trade is questionable and additional econometric analysis is needed incorporating more variables related to U.S. cattle market conditions.

By understanding the determinants of U.S.-Mexican cattle trade and the impact of violence and border closures, this paper will be of interest to a wide range of groups including government agencies, trade specialists, extensions, market economists, and cattle buyers and sellers.

REFERENCES

Acock, A.C. 2012. *A Gentle Introduction to Stata: Revised*, 3rd. ed. College Station, StataCorp LP.

Adewuyi, A.O., and G. Akpokodje. 2010. "Impact of Trade Reform on Nigeria's Trade Flows." *The International Trade Journal* 24(4):411-439.

Bae S., S. Gen, and S.G. Moon. 2011. "Institutional, Geographic, and Facility Factors Affecting Differences in Prices for Wastewater Services." *Annals of Regional Science* 49:767-788.

Brezosky, L. 2014. "USDA Reopens Ojinaga Inspection Facility." *San Antonio Express News*, July. Accessed February 9, 2015, Available at: http://www.expressnews.com/news/us-world/border-mexico/article/USDA-reopens-Ojinaga-inspection-facility-5650364.php.

Cheng, I.H., M.C. Huang, and S.C. Lin 2012. "The Economic Similarity, Regional Economic Agreement and Bilateral Trade Flows" Working Paper, Dept. of Applied Economics, National University of Kaohsiung.

Chionis, D., P. Liargovas, and G. Zanias. 2002. "Greece's Trade with the Balkan Countries: Is It Too Little?" *Journal of Economic Integration* 17(3):608-622.

Federal Bureau of Investigation (FBI). 2014. *Stats and Services.* Washington DC. Accessed November 15, 2014, Available at: http://www.fbi.gov/stats-services/fbi-resources.

Golub, S.S., and C.T. Hsieh. 2000. "Classical Ricardian Theory of Comparative Advantage Revisited." *Review of International Economics* 8(2):221-234.

Guinn, C., and R. Skaggs. 2005. "Live Cattle Imports by Port of Entry from Mexico into the United States: Data and Models." Report, Dept. of Agricultural Economics and Agricultural Business, New Mexico State University.

Hill, R.C., W.E. Griffiths, and G.C. Lim. 2011. *Principles of Econometrics*, 4th. ed. New Jersey: Wiley.

Hwang, H.S. 2013. ECMT 765 Notes. Unpublished, Texas A&M University.

Johns, B., L. Steinhardt, D.G. Walker, D.H. Peters, and D. Bishai. 2013. "Horizontal

Equity and Efficiency at Primary Health Care Facilities in Rural Afghanistan: A Seemingly Unrelated Regression Approach." *Social Science & Medicine* 89:25-31.

Juan, S.J., and D.R. Williams II. 2010. *Mexico Livestock and Products Annual*. Washington DC: U.S. Department of Agriculture, Foreign Agricultural Service. GAIN Rep. MX0064, September.

Livestock Marketing Information Center. 2015. *Feeder Cattle*. Lakewood, Colorado. Accessed November 2014, Available at: http://lmic.info/content/about-lmic.

Lopes, M.A., and P. Riguzzi. 2012. "Borders, Trade, and Politics: Exchange between the United States and Mexican Cattle Industries, 1870-1947." *Hispanic American Historical Review* 92(4):603-635.

Matheis J., J.D. Garcia, and A.T. Halpern. 2012. *Dismay, Economic Concern Greet USDA Cattle Inspection Facility Move*. Accessed November 3, 2014, Available at: http://bigbendnow.com/2012/12/dismay-economic-concern-greet-usda-cattle-inspection-facility-move/.

Mitchell, D.R. 2000. "Predicting Live Cattle Imports by Port of Entry from Mexico into the United States." MS thesis, Dept. of Agr. Econ., New Mexico State University.

Mitchell, D., R. Skaggs, W. Gorman, T. Crawford, and L. Southard. 2001. *Mexican Cattle Exports to U.S.: Current Perspectives.* Washington DC: U.S. Department of Agriculture, Economic Research Service, June-July.

Peel, D.S., R.J. Johnson, and K.H. Mathews. 2010. *Cow-Calf Beef Production in Mexico*. Washington DC: U.S. Department of Agriculture, Economic Research Service. Rep. LDP-M-196-01, November.

Peel, D.S., K.H. Mathews, and R.J. Johnson. 2011. *Trade, the Expanding Mexican Beef Industry, and Feedlot and Stocker Cattle Production in Mexico*. Washington DC: U.S. Department of Agriculture, Economic Research Service. Rep. LDP-M-206-01, August.

Sherman, C. 2010. "Border Violence Spills onto Mexican Ranches." *Associated Press*. Accessed March 12, 2014, Available at: http://www.boston.com/news/nation/articles/2010/07/07/border_violence_spills_onto_mexican_ranches_farms/.

Skaggs, R., D. Mitchell, W. Gorman, T. Crawford, and L. Southard. 2001. "Forecasting

Mexican Live Cattle Exports to the United States." Paper presented to the Western Agricultural Economics Association, Logan, UT, July.

Texas Department of Agriculture. 2010. *USDA Suspends Imports Livestock Inspection in Reynosa and Nuevo Laredo.* Austin, Texas. Accessed November 12, 2014, Available at: http://www.texasagriculture.gov/NewsEvents/TDAPublications/TradeActionNetwork/USDASuspendsImportLivestockInspection.aspx.

U.S. Department of Agriculture, Foreign Agricultural Service (USDA FAS). 2015. *Global Agricultural Trade System.* Washington DC. Accessed January 2, 2015, Available at: http://apps.fas.usda.gov/gats/default.aspx.

U.S. Department of Agriculture, Agricultural Markets Service (USDA AMS). 2014. *Amarillo Livestock Market News.* Las Cruces, NM. Accessed January 10, 2015, Available at: www.ams.usda.gov/lsmnpubs/.

U.S. Department of Agriculture, Economics Research Service (USDA ERS). 2014. *International Markets & Trade.* Washington DC. Accessed December 20, 2014, Available at: http://www.ers.usda.gov/topics/international-markets-trade/countries-regions.aspx.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS). 2014. *Import Live Animals.* Washington DC. Accessed Feb 3, 2015 Available at: http://www.aphis.usda.gov/wps/portal/aphis/home/.

Wooldridge, J.M. 2013. *Introductory Econometrics: A Modern Approach*, 5th. ed. Mason: South-Western.

World Institute for Strategic Economic Research Trade (WiserTrade). 2015. *Port HS Database*. Leverette, Massachusetts. Accessed January 19, 2015, Available at: http://www.wisertrade.org/home/portal/index.jsp.

Xu, X. 2000. "International Trade and Environmental Policy: How Effective is 'Eco-Dumping'?" *Economic Modelling* 17:71-90.

Zellner, A. 1962. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." *Journal of the American Statistical Association* 57: 348-368.

APPENDIX

## Table 1. An Overview of All Variables Included in this Analysis

| Variable Name | Variable Definition |
|---|---|
| Santa Teresa | number of cattle imported from Santa Teresa port of entry |
| STlag | lagged number of cattle imported from Santa Teresa port of entry |
| Nogales | number of cattle imported from Nogales port of entry |
| Laredo | number of cattle imported from Laredo port of entry |
| EaglePass | number of cattle imported from Eagle Pass port of entry |
| Hildago | number of cattle imported from Hildago port of entry |
| Douglas | number of cattle imported from Douglas port of entry |
| DelRio | number of cattle imported from Del Rio port of entry |
| Columbus | number of cattle imported from Columbus port of entry |
| Presidio | number of cattle imported from Presidio port of entry |
| Plag | lagged number of cattle imported from Presidio port of entry |
| SanLuis | number of cattle imported from San Luis port of entry |
| Pdummy | monthly dummy variable for Presidio port of entry (0=open, 1 = closure) |
| Ldummy | monthly dummy variable for Laredo port of entry (0=open, 1 = closure) |
| Hdummy | monthly dummy variable for Hildago port of entry (0=open, 1 = closure) |
| Tdummy | monthly dummy variable for Presidio port of entry with temporary facility opened |
| Drought | cumulative drought severity in south region |
| Corn | average price of corn received by farmers |
| Usfeeder | U.S. feeder steer prices |
| Usfed | U.S. fed cattle prices |
| Mxfeeder | Mexican feeder steer prices |
| Exchrate | average exchange rate, USD/MXN |
| Oil | average of three spots |
| Trend | linear variable |
| Trend2 | seasonal variable |
| Jan | monthly dummy variable for the month of January |
| Feb | monthly dummy variable for the month of February |
| Mar | monthly dummy variable for the month of March |
| Apr | monthly dummy variable for the month of April |
| May | monthly dummy variable for the month of May |
| Jun | monthly dummy variable for the month of June |
| Jul | monthly dummy variable for the month of July |
| Aug | monthly dummy variable for the month of August |
| Sep | monthly dummy variable for the month of September |
| Oct | monthly dummy variable for the month of October |
| Nov | monthly dummy variable for the month of November |
| Dec | monthly dummy variable for the month of December |
| $b_{0....}b_k$ | estimated parameters |

**Table 2. Results of OLS, Santa Teresa Port of Entry**

| | |
|---|---|
| **Number of obs** | 68 |
| **F( 33, 34)** | 16.09 |
| **Prob > F** | 0 |
| **R-squared** | 0.9398 |
| **Adj R-squared** | 0.8814 |
| **Root MSE** | 5942.2 |

| SantaTeresa | Coef. | Std. Err. | t | P>t |
|---|---|---|---|---|
| **STlag** | - | - | - | - |
| **Nogales** | - | - | - | - |
| **Laredo** | - | - | - | - |
| **EaglePass** | - | - | - | - |
| **Hidalgo** | - | - | - | - |
| **Douglas** | 0.9550405 | 0.3421264 | 2.79 | 0.009 |
| **DelRio** | -0.7655267 | 0.2706927 | -2.83 | 0.008 |
| **Columbus** | 1.417242 | 0.3555655 | 3.99 | 0 |
| **Presidio** | 1.037587 | 0.3327957 | 3.12 | 0.004 |
| **Plag** | - | - | - | - |
| **SanLuis** | - | - | - | - |
| **Pdummy** | 16212.26 | 6697.33 | 2.42 | 0.021 |
| **Tdummy** | - | - | - | - |
| **Corn** | - | - | - | - |
| **Drought** | - | - | - | - |
| **USfeeder** | - | - | - | - |
| **USfed** | - | - | - | - |
| **exchrate** | - | - | - | - |
| **MXfeeder** | - | - | - | - |
| **oil** | - | - | - | - |
| **Jan** | - | - | - | - |
| **Feb** | - | - | - | - |
| **Mar** | - | - | - | - |
| **Apr** | - | - | - | - |
| **May** | - | - | - | - |
| **Jun** | - | - | - | - |
| **Jul** | - | - | - | - |
| **Aug** | - | - | - | - |
| **Sep** | - | - | - | - |
| **Oct** | - | - | - | - |
| **Nov** | - | - | - | - |
| **Trend** | - | - | - | - |
| **Trend2** | -22.87134 | 9.22856 | -2.48 | 0.018 |
| **_cons** | - | - | - | - |

## Table 3. Correlation Table

| | SantaTeresa | Nogales | Laredo | EaglePass | Hildago | Douglas | DelRio | Columbus | Presidio | SanLuis | Pdummy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SantaTeresa** | 1 | | | | | | | | | | |
| **Nogales** | 0.6412 | 1 | | | | | | | | | |
| **Laredo** | 0.4501 | 0.3408 | 1 | | | | | | | | |
| **EaglePass** | 0.3479 | 0.4429 | 0.1333 | 1 | | | | | | | |
| **Hildago** | 0.4993 | 0.3225 | 0.5265 | 0.4081 | 1 | | | | | | |
| **Douglas** | 0.5825 | 0.5865 | 0.0594 | 0.2575 | 0.2771 | 1 | | | | | |
| **DelRio** | 0.0501 | 0.131 | -0.4474 | 0.0632 | -0.1131 | 0.3622 | 1 | | | | |
| **Columbus** | 0.474 | 0.2227 | -0.0223 | -0.0586 | -0.1141 | 0.4738 | 0.1649 | 1 | | | |
| **Presidio** | 0.5334 | 0.4392 | -0.1186 | 0.5539 | 0.2581 | 0.5595 | 0.5759 | 0.2953 | 1 | | |
| **SanLuis** | 0.3043 | 0.5759 | 0.1608 | 0.0513 | 0.0139 | 0.6043 | 0.1012 | 0.3371 | 0.1463 | 1 | |
| **Pdummy** | 0.1033 | 0.0768 | 0.3741 | -0.303 | 0.2536 | -0.078 | -0.5192 | -0.0856 | -0.5606 | 0.1795 | 1 |

**Table 4. Results of OLS**

| Equation | RMSE | R-sq | Adj R-sq | P |
|---|---|---|---|---|
| **SantaTeresa** | 5942.2 | 0.9398 | 0.8814 | 0.0000 |
| **Nogales** | 2394.5 | 0.9314 | 0.8648 | 0.0000 |
| **Laredo** | 902.4 | 0.8791 | 0.7918 | 0.0000 |
| **EaglePass** | 2999.0 | 0.8393 | 0.6834 | 0.0000 |
| **Hidalgo** | 1143.9 | 0.8333 | 0.6714 | 0.0000 |
| **Douglas** | 2686.7 | 0.9381 | 0.8781 | 0.0000 |
| **DelRio** | 3387.3 | 0.9047 | 0.8122 | 0.0000 |
| **Columbus** | 2366.1 | 0.8416 | 0.6880 | 0.0000 |
| **Presidio** | 2700.4 | 0.9514 | 0.9042 | 0.0000 |
| **SanLuis** | 541.7 | 0.7690 | 0.5447 | 0.0003 |

## Table 4. Continued

| | SantaTeresa b/se | Nogales b/se | Laredo b/se | EaglePass b/se | Hidalgo b/se | Douglas b/se | DelRio b/se | Columbus b/se | Presidio b/se | SanLuis b/se |
|---|---|---|---|---|---|---|---|---|---|---|
| **SantaTeresa** | - | - | - | - | - | 0.195** | -0.249** | 0.225*** | 0.214** | - |
| | - | - | - | - | - | -0.07 | -0.09 | -0.06 | -0.07 | - |
| **STlag** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Nogales** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Laredo** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **EaglePass** | - | - | - | - | - | - | -0.550** | - | - | - |
| | - | - | - | - | - | - | -0.17 | - | - | - |
| **Hidalgo** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Douglas** | 0.955** | - | - | - | - | - | - | -0.380** | - | 0.089** |
| | -0.34 | - | - | - | - | - | - | -0.14 | - | -0.03 |
| **DelRio** | -0.766** | - | - | -0.431** | - | - | - | - | 0.363** | - |
| | -0.27 | - | - | -0.13 | - | - | - | - | -0.12 | - |
| **Columbus** | 1.417*** | - | - | - | - | -0.490** | - | - | - | - |
| | -0.36 | - | - | - | - | -0.18 | - | - | - | - |
| **Presidio** | 1.038** | - | - | - | - | - | 0.571** | - | - | - |
| | -0.33 | - | - | - | - | - | -0.19 | - | - | - |
| **Plag** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **SanLuis** | - | - | - | - | - | 2.194** | - | - | - | - |
| | - | - | - | - | - | -0.76 | - | - | - | - |
| **Pdummy** | 16212.263* | - | - | - | - | - | - | - | -9949.483** | - |
| | -6697.33 | - | - | - | - | - | - | - | -2819.25 | - |
| **Tdummy** | - | - | - | - | - | - | -9805.377* | - | - | - |
| | - | - | - | - | - | - | -4269.43 | - | - | - |
| **Corn** | - | -2805.836** | - | - | - | - | -2614.082* | - | - | - |
| | - | -782.8 | - | - | - | - | -1220.12 | - | - | - |
| **Drought** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **USfeeder** | - | - | - | - | 125.100* | - | - | - | - | - |
| | - | - | - | - | -55.38 | - | - | - | - | - |
| **USfed** | - | - | - | - | - | - | 723.036** | - | -428.243* | - |
| | - | - | - | - | - | - | -222.53 | - | -189.34 | - |
| **exchrate** | - | 4193.707** | - | - | - | - | - | - | 5263.334** | - |
| | - | -1451.1 | - | - | - | - | - | - | -1587.83 | - |
| **MXfeeder** | - | - | - | - | - | - | - | -233.659* | - | - |
| | - | - | - | - | - | - | - | -94.49 | - | - |
| **oil** | - | 269.478** | - | - | - | - | - | - | - | - |
| | - | -82.83 | - | - | - | - | - | - | - | - |
| **Jan** | - | - | - | - | - | -6825.484* | - | -6541.849** | - | - |
| | - | - | - | - | - | -2702.63 | - | -2338.64 | - | - |
| **Feb** | - | - | - | - | -3014.264* | -10439.207*** | - | -7600.789** | - | - |
| | - | - | - | - | -1322.15 | -2812.88 | - | -2631.28 | - | - |
| **Mar** | - | - | - | - | -3130.237* | -10814.118*** | - | -8138.029** | - | - |
| | - | - | - | - | -1282.2 | -2686.93 | - | -2513.85 | - | - |
| **Apr** | - | - | - | - | - | -9454.799** | - | -7787.519** | - | - |
| | - | - | - | - | - | -2678.5 | - | -2412.48 | - | - |
| **May** | - | - | - | 7315.827* | - | -10147.043*** | - | -8333.679** | - | - |
| | - | - | - | -3328.4 | - | -2669.4 | - | -2415.13 | - | - |
| **Jun** | - | -8089.624* | - | - | - | -10643.126** | - | -7414.198* | -9048.592* | - |
| | - | -3247.95 | - | - | - | -3517.4 | - | -3250.11 | -3668.32 | - |
| **Jul** | - | -10911.510** | - | - | - | -11693.809** | - | -9043.785* | - | - |
| | - | -3556.72 | - | - | - | -4038.86 | - | -3655.93 | - | - |
| **Aug** | - | -13204.715*** | - | - | - | -12264.244** | - | -7812.301* | - | - |
| | - | -3403.41 | - | - | - | -4076.12 | - | -3810.86 | - | - |
| **Sep** | - | -11894.095** | - | - | - | -10382.900* | - | - | - | - |
| | - | -3404.63 | - | - | - | -4081.71 | - | - | - | - |
| **Oct** | - | - | - | - | - | - | - | - | - | -1505.418* |
| | - | - | - | - | - | - | - | - | - | -583.95 |
| **Nov** | - | - | - | - | - | 8966.401*** | - | - | - | -1232.581* |
| | - | - | - | - | - | -2208 | - | - | - | -499.6 |
| **Trend** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Trend2** | -22.871* | - | - | -12.043* | - | - | - | 8.185* | - | - |
| | -9.23 | - | - | -4.62 | - | - | - | -3.74 | - | - |
| **_cons** | - | - | - | -55173.398* | - | - | - | - | - | - |
| | - | - | - | -26924.35 | - | - | - | - | - | - |

* p < 0.05, ** p < 0.01, *** p < 0.001
Standard errors are given below coffeicients in parenthesis.

**Table 5. Results of SUR**

| Equation | RMSE | R-sq | Chi2 | P |
|---|---|---|---|---|
| **SantaTeresa** | 4888.9 | 0.9185 | 1224.4 | 0.0000 |
| **Nogales** | 1805.3 | 0.9220 | 956.9 | 0.0000 |
| **Laredo** | 673.5 | 0.8653 | 535.6 | 0.0000 |
| **EaglePass** | 2327.4 | 0.8065 | 424.3 | 0.0000 |
| **Hidalgo** | 872.9 | 0.8058 | 391.0 | 0.0000 |
| **Douglas** | 2165.1 | 0.9196 | 1133.6 | 0.0000 |
| **DelRio** | 2687.5 | 0.8800 | 749.6 | 0.0000 |
| **Columbus** | 1838.4 | 0.8088 | 445.4 | 0.0000 |
| **Presidio** | 2095.0 | 0.9415 | 1411.1 | 0.0000 |
| **SanLuis** | 401.5 | 0.7462 | 262.8 | 0.0000 |

## Table 5. Continued

| | SantaTeresa b/se | Nogales b/se | Laredo b/se | EaglePass b/se | Hidalgo b/se | Douglas b/se | DelRio b/se | Columbus b/se | Presidio b/se | SanLuis b/se |
|---|---|---|---|---|---|---|---|---|---|---|
| **SantaTeresa** | - | 0.224*** | 0.048** | -0.176** | - | 0.305*** | -0.393*** | 0.288*** | 0.280*** | -0.033** |
| | - | -0.04 | -0.02 | -0.06 | - | -0.04 | -0.06 | -0.03 | -0.04 | -0.01 |
| **STlag** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Nogales** | 1.379*** | - | - | 0.430** | 0.158** | -0.323* | 0.482** | -0.347** | -0.504*** | - |
| | -0.27 | - | - | -0.15 | -0.06 | -0.13 | -0.17 | -0.11 | -0.13 | - |
| **Laredo** | 2.097** | - | - | -1.625*** | 0.654*** | - | - | - | -0.985** | - |
| | -0.74 | - | - | -0.36 | -0.14 | - | - | - | -0.34 | - |
| **EaglePass** | -0.690** | 0.274** | -0.147*** | - | - | 0.397*** | -0.831*** | 0.301** | 0.226* | - |
| | -0.23 | -0.09 | -0.03 | - | - | -0.1 | -0.11 | -0.09 | -0.11 | - |
| **Hidalgo** | - | 0.692** | 0.407*** | - | - | -0.622* | -0.691* | -0.759** | 1.361*** | - |
| | - | -0.24 | -0.09 | - | - | -0.27 | -0.35 | -0.23 | -0.26 | - |
| **Douglas** | 1.492*** | -0.257* | - | 0.494*** | -0.113* | - | 0.588*** | -0.654*** | - | 0.137*** |
| | -0.22 | -0.11 | - | -0.13 | -0.05 | - | -0.14 | -0.09 | - | -0.02 |
| **DelRio** | -1.211*** | 0.241** | - | -0.651*** | -0.079* | 0.370*** | - | 0.274*** | 0.531*** | - |
| | -0.17 | -0.08 | - | -0.08 | -0.04 | -0.09 | - | -0.08 | -0.08 | - |
| **Columbus** | 1.819*** | -0.355** | - | 0.483** | -0.177** | -0.844*** | 0.562*** | - | - | 0.076** |
| | -0.21 | -0.12 | - | -0.15 | -0.05 | -0.11 | -0.16 | - | - | -0.03 |
| **Presidio** | 1.358*** | -0.396*** | -0.110** | 0.278* | 0.244*** | - | 0.836*** | - | - | - |
| | -0.21 | -0.1 | -0.04 | -0.13 | -0.05 | - | -0.12 | - | - | - |
| **Plag** | - | - | 0.067* | - | -0.094* | - | - | - | 0.218* | - |
| | - | - | -0.03 | - | -0.04 | - | - | - | -0.1 | - |
| **SanLuis** | -3.980** | - | - | - | - | 3.363*** | - | 1.456** | - | - |
| | -1.27 | - | - | - | - | -0.49 | - | -0.52 | - | - |
| **Pdummy** | 23703.226*** | - | -1805.553* | - | - | -4900.395* | 11015.278*** | -5425.731** | -10189.525*** | - |
| | -4630.39 | - | -741 | - | - | -2220.98 | -2745.07 | -1911.79 | -1981.17 | - |
| **Tdummy** | -15472.089** | - | - | - | - | - | -9607.347** | 4371.037* | - | - |
| | -5424.91 | - | - | - | - | - | -3011.19 | -2199.76 | - | - |
| **Corn** | - | -2240.072*** | - | -1643.612* | 794.248** | - | -1939.734* | - | - | - |
| | - | -550.13 | - | -774.33 | -292.41 | - | -854.44 | - | - | - |
| **Drought** | - | - | 15.888* | 50.855* | - | - | - | - | - | - |
| | - | - | -7.01 | -23.04 | - | - | - | - | - | - |
| **USfeeder** | - | -195.735* | - | 211.202* | 133.423*** | - | 297.549* | - | -312.022*** | -43.773* |
| | - | -85.51 | - | -107.73 | -38.88 | - | -120.07 | - | -94.61 | -19.38 |
| **USfed** | 1138.397*** | - | -134.406** | - | 120.790* | - | 627.343*** | - | -517.080*** | - |
| | -292.17 | - | -45.58 | - | -59.71 | - | -154.56 | - | -131.32 | - |
| **exchrate** | -8442.771** | 4245.240*** | 1129.014** | - | -1854.009*** | - | - | - | 5902.563*** | - |
| | -2649.2 | -1016.69 | -417.76 | - | -531.11 | - | - | - | -1116.61 | - |
| **MXfeeder** | - | - | - | - | -110.320*** | -164.743* | - | -216.056** | 224.101** | - |
| | - | - | - | - | -33.15 | -79.49 | - | -66.22 | -78.38 | - |
| **oil** | -485.487** | 283.223*** | - | - | -92.671** | - | -193.215* | - | 264.620*** | - |
| | -159.5 | -58.41 | - | - | -30.88 | - | -91.89 | - | -71.61 | - |
| **Jan** | 8935.731* | - | - | - | -2405.792** | -5726.433** | - | -6945.355*** | - | - |
| | -4389.98 | - | - | - | -831.6 | -1859.68 | - | -1622.13 | - | - |
| **Feb** | 11317.751* | - | - | - | -3686.145*** | -9887.562*** | - | -9366.635*** | - | - |
| | -4909.31 | - | - | - | -925.66 | -1948.71 | - | -1818.04 | - | - |
| **Mar** | - | - | 2112.306** | 6905.079** | -4571.273*** | -11304.616*** | - | -9887.904*** | 6422.236** | 1038.754* |
| | - | - | -748.75 | -2469.32 | -893.84 | -1864.18 | - | -1727.15 | -2179.18 | -448.66 |
| **Apr** | 9559.456* | - | 1664.889* | 6426.168** | -3414.841*** | -9152.346*** | - | -8942.235*** | - | - |
| | -4593.35 | - | -729.7 | -2369.73 | -886.7 | -1842.39 | - | -1662.81 | - | - |
| **May** | 15839.098*** | -3864.677* | 1717.393* | 9703.412*** | -2890.236** | -10529.765*** | 7009.707* | -10225.332*** | - | - |
| | -4637.34 | -1967.19 | -741.35 | -2328.16 | -909.21 | -1831.82 | -2755.68 | -1671.49 | - | - |
| **Jun** | 30550.801*** | -10371.526*** | - | 9559.294** | - | -9878.168*** | 13030.459*** | -9829.252*** | -10162.502*** | - |
| | -5700.95 | -2279.43 | - | -3028.27 | - | -2428.26 | -3398.09 | -2260.65 | -2573.41 | - |
| **Jul** | 31029.297*** | -12394.476*** | - | 9122.767** | - | -11025.872*** | 11093.344** | -11541.624*** | -8256.848** | - |
| | -6588.2 | -2501.29 | - | -3492.13 | - | -2794.92 | -3939.14 | -2549.09 | -3065.62 | - |
| **Aug** | 32656.389*** | -14757.887*** | - | 10586.440** | - | -11505.512*** | 12510.379** | -11158.831*** | -9764.724** | - |
| | -6661.53 | -2394.42 | - | -3536.21 | - | -2829.02 | -3993.4 | -2644.85 | -3074.45 | - |
| **Sep** | 26271.796*** | -13090.338*** | - | 11773.049*** | - | -9709.347*** | 12052.565** | -10134.095*** | -8044.402** | - |
| | -6599.55 | -2394.83 | - | -3416.66 | - | -2823.57 | -3879.92 | -2592.18 | -3021.44 | - |
| **Oct** | - | -4711.196* | - | - | - | - | - | - | -4313.010* | -1373.077*** |
| | - | -1886.87 | - | - | - | - | - | - | -2178.62 | -411.79 |
| **Nov** | -11438.900** | - | - | -5876.703** | 1643.794* | 9846.724*** | -5261.340* | 5951.691*** | - | -1533.913*** |
| | -4048.9 | - | - | -2046.83 | -794.16 | -1550.4 | -2341.08 | -1589.49 | - | -346.09 |
| **Trend** | - | - | - | 640.496** | - | -418.295* | 653.468* | - | - | - |
| | - | - | - | -228.07 | - | -213.36 | -257.28 | - | - | - |
| **Trend2** | -29.773*** | - | - | -13.959*** | - | 9.795** | -20.328*** | 9.242*** | 8.844** | - |
| | -6.38 | - | - | -3.19 | - | -3.06 | -3.38 | -2.6 | -3.07 | - |
| **_cons** | - | - | - | -43134.017* | - | - | - | 30745.933* | - | - |
| | - | - | - | -18934.26 | - | - | - | -15248.12 | - | - |

$* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Standard errors are given below coffeicients in parenthesis.

## Table 6. Results of OLS and SUR

| | OLS | SUR | OLS | SUR | OLS | SUR | OLS | SUR | OLS | SUR |
|---|---|---|---|---|---|---|---|---|---|---|
| | SantaTeresa | SantaTeresa | Nogales | Nogales | Laredo | Laredo | EaglePass | EaglePass | Hidalgo | Hidalgo |
| | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se |
| **SantaTeresa** | - | - | - | 0.224*** | - | 0.048** | - | -0.176** | - | - |
| | - | - | - | -0.04 | - | -0.02 | - | -0.06 | - | - |
| **STlag** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Nogales** | - | 1.379*** | - | - | - | - | - | 0.430** | - | 0.158** |
| | - | -0.27 | - | - | - | - | - | -0.15 | - | -0.06 |
| **Laredo** | - | 2.097** | - | - | - | - | - | -1.625*** | - | 0.654*** |
| | - | -0.74 | - | - | - | - | - | -0.36 | - | -0.14 |
| **EaglePass** | - | -0.690** | - | 0.274** | - | -0.147*** | - | - | - | - |
| | - | -0.23 | - | -0.09 | - | -0.03 | - | - | - | - |
| **Hidalgo** | - | - | - | 0.692** | - | 0.407*** | - | - | - | - |
| | - | - | - | -0.24 | - | -0.09 | - | - | - | - |
| **Douglas** | 0.955** | 1.492*** | - | -0.257* | - | - | - | 0.494*** | - | -0.113* |
| | -0.34 | -0.22 | - | -0.11 | - | - | - | -0.13 | - | -0.05 |
| **DelRio** | -0.766** | -1.211*** | - | 0.241** | - | - | -0.431** | -0.651*** | - | -0.079* |
| | -0.27 | -0.17 | - | -0.08 | - | - | -0.13 | -0.08 | - | -0.04 |
| **Columbus** | 1.417*** | 1.819*** | - | -0.355** | - | - | - | 0.483** | - | -0.177** |
| | -0.36 | -0.21 | - | -0.12 | - | - | - | -0.15 | - | -0.05 |
| **Presidio** | 1.038** | 1.358*** | - | -0.396*** | - | -0.110** | - | 0.278* | - | 0.244*** |
| | -0.33 | -0.21 | - | -0.1 | - | -0.04 | - | -0.13 | - | -0.05 |
| **Plag** | - | - | - | - | - | 0.067* | - | - | - | -0.094* |
| | - | - | - | - | - | -0.03 | - | - | - | -0.04 |
| **SanLuis** | - | -3.980** | - | - | - | - | - | - | - | - |
| | - | -1.27 | - | - | - | - | - | - | - | - |
| **Pdummy** | 16212.263* | 23703.226*** | - | - | - | -1805.553* | - | - | - | - |
| | -6697.33 | -4630.39 | - | - | - | -741 | - | - | - | - |
| **Tdummy** | - | -15472.089** | - | - | - | - | - | - | - | - |
| | - | -5424.91 | - | - | - | - | - | - | - | - |
| **Corn** | - | - | -2805.836** | -2240.072*** | - | - | - | -1643.612* | - | 794.248** |
| | - | - | -782.8 | -550.13 | - | - | - | -774.33 | - | -292.41 |
| **Drought** | - | - | - | - | - | 15.888* | - | 50.855* | - | - |
| | - | - | - | - | - | -7.01 | - | -23.04 | - | - |
| **USfeeder** | - | - | - | -195.735* | - | - | - | 211.202* | 125.100* | 133.423*** |
| | - | - | - | -85.51 | - | - | - | -107.73 | -55.38 | -38.88 |
| **USfed** | - | 1138.397*** | - | - | - | -134.406** | - | - | - | 120.790* |
| | - | -292.17 | - | - | - | -45.58 | - | - | - | -59.71 |
| **exchrate** | - | -8442.771** | 4193.707** | 4245.240*** | - | 1129.014** | - | - | - | -1854.009*** |
| | - | -2649.2 | -1451.1 | -1016.69 | - | -417.76 | - | - | - | -531.11 |
| **MXfeeder** | - | - | - | - | - | - | - | - | - | -110.320*** |
| | - | - | - | - | - | - | - | - | - | -33.15 |
| **oil** | - | -485.487** | 269.478** | 283.223*** | - | - | - | - | - | -92.671** |
| | - | -159.5 | -82.83 | -58.41 | - | - | - | - | - | -30.88 |
| **Jan** | - | 8935.731* | - | - | - | - | - | - | - | -2405.792** |
| | - | -4389.98 | - | - | - | - | - | - | - | -831.6 |
| **Feb** | - | 11317.751* | - | - | - | - | - | - | -3014.264* | -3686.145*** |
| | - | -4909.31 | - | - | - | - | - | - | -1322.15 | -925.66 |
| **Mar** | - | - | - | - | - | 2112.306** | - | 6905.079** | -3130.237* | -4571.273*** |
| | - | - | - | - | - | -748.75 | - | -2469.32 | -1282.2 | -893.84 |
| **Apr** | - | 9559.456* | - | - | - | 1664.889* | - | 6426.168** | - | -3414.841*** |
| | - | -4593.35 | - | - | - | -729.7 | - | -2369.73 | - | -886.7 |
| **May** | - | 15839.098*** | - | -3864.677* | - | 1717.393* | 7315.827* | 9703.412*** | - | -2890.236** |
| | - | -4637.34 | - | -1967.19 | - | -741.35 | -3328.4 | -2328.16 | - | -909.21 |
| **Jun** | - | 30550.801*** | -8089.624* | -10371.526*** | - | - | - | 9559.294** | - | - |
| | - | -5700.95 | -3247.95 | -2279.43 | - | - | - | -3028.27 | - | - |
| **Jul** | - | 31029.297*** | -10911.510** | -12394.476*** | - | - | - | 9122.767** | - | - |
| | - | -6588.2 | -3556.72 | -2501.29 | - | - | - | -3492.13 | - | - |
| **Aug** | - | 32656.389*** | -13204.715*** | -14757.887*** | - | - | - | 10586.440** | - | - |
| | - | -6661.53 | -3403.41 | -2394.42 | - | - | - | -3536.21 | - | - |
| **Sep** | - | 26271.796*** | -11894.095** | -13090.338*** | - | - | - | 11773.049*** | - | - |
| | - | -6599.55 | -3404.63 | -2394.83 | - | - | - | -3416.66 | - | - |
| **Oct** | - | - | - | -4711.196* | - | - | - | - | - | - |
| | - | - | - | -1886.87 | - | - | - | - | - | - |
| **Nov** | - | -11438.900** | - | - | - | - | - | -5876.703** | - | 1643.794* |
| | - | -4048.9 | - | - | - | - | - | -2046.83 | - | -794.16 |
| **Trend** | - | - | - | - | - | - | - | 640.496** | - | - |
| | - | - | - | - | - | - | - | -228.07 | - | - |
| **Trend2** | -22.871* | -29.773*** | - | - | - | - | -12.043* | -13.959*** | - | - |
| | -9.23 | -6.38 | - | - | - | - | -4.62 | -3.19 | - | - |
| **_cons** | - | - | - | - | - | - | -55173.398* | -43134.017* | - | - |
| | - | - | - | - | - | - | -26924.35 | -18934.26 | - | - |

* p < 0.05, ** p < 0.01, *** p < 0.001
Standard errors are given below coffeicients in parenthesis.

## Table 6. Continued

| | OLS Douglas b/se | SUR Douglas b/se | OLS DelRio b/se | SUR DelRio b/se | OLS Columbus b/se | SUR Columbus b/se | OLS Presidio b/se | SUR Presidio b/se | OLS SanLuis b/se | SUR SanLuis b/se |
|---|---|---|---|---|---|---|---|---|---|---|
| **SantaTeresa** | 0.195** | 0.305*** | -0.249** | -0.393*** | 0.225*** | 0.288*** | 0.214** | 0.280*** | - | -0.033** |
| | -0.07 | -0.04 | -0.09 | -0.06 | -0.06 | -0.03 | -0.07 | -0.04 | - | -0.01 |
| **STlag** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **Nogales** | - | -0.323* | - | 0.482** | - | -0.347** | - | -0.504*** | - | - |
| | - | -0.13 | - | -0.17 | - | -0.11 | - | -0.13 | - | - |
| **Laredo** | - | - | - | - | - | - | - | -0.985** | - | - |
| | - | - | - | - | - | - | - | -0.34 | - | - |
| **EaglePass** | - | 0.397*** | -0.550** | -0.831*** | - | 0.301** | - | 0.226* | - | - |
| | - | -0.1 | -0.17 | -0.11 | - | -0.09 | - | -0.11 | - | - |
| **Hidalgo** | - | -0.622* | - | -0.691* | - | -0.759** | - | 1.361*** | - | - |
| | - | -0.27 | - | -0.35 | - | -0.23 | - | -0.26 | - | - |
| **Douglas** | - | - | - | 0.588*** | -0.380** | -0.654*** | - | - | 0.089** | 0.137*** |
| | - | - | - | -0.14 | -0.14 | -0.09 | - | - | -0.03 | -0.02 |
| **DelRio** | - | 0.370*** | - | - | - | 0.274*** | 0.363** | 0.531*** | - | - |
| | - | -0.09 | - | - | - | -0.08 | -0.12 | -0.08 | - | - |
| **Columbus** | -0.490** | -0.844*** | - | 0.562*** | - | - | - | - | - | 0.076** |
| | -0.18 | -0.11 | - | -0.16 | - | - | - | - | - | -0.03 |
| **Presidio** | - | - | 0.571** | 0.836*** | - | - | - | - | - | - |
| | - | - | -0.19 | -0.12 | - | - | - | - | - | - |
| **Plag** | - | - | - | - | - | - | - | 0.218* | - | - |
| | - | - | - | - | - | - | - | -0.1 | - | - |
| **SanLuis** | 2.194** | 3.363*** | - | - | - | 1.456** | - | - | - | - |
| | -0.76 | -0.49 | - | - | - | -0.52 | - | - | - | - |
| **Pdummy** | - | -4900.395* | - | 11015.278*** | - | -5425.731** | -9949.483** | -10189.525*** | - | - |
| | - | -2220.98 | - | -2745.07 | - | -1911.79 | -2819.25 | -1981.17 | - | - |
| **Tdummy** | - | - | -9805.377* | -9607.347** | - | 4371.037* | - | - | - | - |
| | - | - | -4269.43 | -3011.19 | - | -2199.76 | - | - | - | - |
| **Corn** | - | - | -2614.082* | -1939.734* | - | - | - | - | - | - |
| | - | - | -1220.12 | -854.44 | - | - | - | - | - | - |
| **Drought** | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - |
| **USfeeder** | - | - | - | 297.549* | - | - | - | -312.022*** | - | -43.773* |
| | - | - | - | -120.07 | - | - | - | -94.61 | - | -19.38 |
| **USfed** | - | - | 723.036** | 627.343*** | - | - | -428.243* | -517.080*** | - | - |
| | - | - | -222.53 | -154.56 | - | - | -189.34 | -131.32 | - | - |
| **exchrate** | - | - | - | - | - | - | 5263.334** | 5902.563*** | - | - |
| | - | - | - | - | - | - | -1587.83 | -1116.61 | - | - |
| **MXfeeder** | - | -164.743* | - | - | -233.659* | -216.056** | - | 224.101** | - | - |
| | - | -79.49 | - | - | -94.49 | -66.22 | - | -78.38 | - | - |
| **oil** | - | - | - | -193.215* | - | - | - | 264.620*** | - | - |
| | - | - | - | -91.89 | - | - | - | -71.61 | - | - |
| **Jan** | -6825.484* | -5726.433** | - | - | -6541.849** | -6945.355*** | - | - | - | - |
| | -2702.63 | -1859.68 | - | - | -2338.64 | -1622.13 | - | - | - | - |
| **Feb** | -10439.207*** | -9887.562*** | - | - | -7600.789** | -9366.635*** | - | - | - | - |
| | -2812.88 | -1948.71 | - | - | -2631.28 | -1818.04 | - | - | - | - |
| **Mar** | -10814.118*** | -11304.616*** | - | - | -8138.029** | -9887.904*** | - | 6422.236** | - | 1038.754* |
| | -2686.93 | -1864.18 | - | - | -2513.85 | -1727.15 | - | -2179.18 | - | -448.66 |
| **Apr** | -9454.799** | -9152.346*** | - | - | -7787.519** | -8942.235*** | - | - | - | - |
| | -2678.5 | -1842.39 | - | - | -2412.48 | -1662.81 | - | - | - | - |
| **May** | -10147.043*** | -10529.765*** | - | 7009.707* | -8333.679** | -10225.332*** | - | - | - | - |
| | -2669.4 | -1831.82 | - | -2755.68 | -2415.13 | -1671.49 | - | - | - | - |
| **Jun** | -10643.126** | -9878.168*** | - | 13030.459*** | -7414.198* | -9829.252*** | -9048.592* | -10162.502*** | - | - |
| | -3517.4 | -2428.26 | - | -3398.09 | -3250.11 | -2260.65 | -3668.32 | -2573.41 | - | - |
| **Jul** | -11693.809** | -11025.872*** | - | 11093.344** | -9043.785* | -11541.624*** | - | -8256.848** | - | - |
| | -4038.86 | -2794.92 | - | -3939.14 | -3655.93 | -2549.09 | - | -3065.62 | - | - |
| **Aug** | -12264.244** | -11505.512*** | - | 12510.379** | -7812.301* | -11158.831*** | - | -9764.724** | - | - |
| | -4076.12 | -2829.02 | - | -3993.4 | -3810.86 | -2644.85 | - | -3074.45 | - | - |
| **Sep** | -10382.900* | -9709.347*** | - | 12052.565** | - | -10134.095*** | - | -8044.402** | - | - |
| | -4081.71 | -2823.57 | - | -3879.92 | - | -2592.18 | - | -3021.44 | - | - |
| **Oct** | - | - | - | - | - | - | - | -4313.010* | -1505.418* | -1373.077*** |
| | - | - | - | - | - | - | - | -2178.62 | -583.95 | -411.79 |
| **Nov** | 8966.401*** | 9846.724*** | - | -5261.340* | - | 5951.691*** | - | - | -1232.581* | -1533.913*** |
| | -2208 | -1550.4 | - | -2341.08 | - | -1589.49 | - | - | -499.6 | -346.09 |
| **Trend** | - | -418.295* | - | 653.468* | - | - | - | - | - | - |
| | - | -213.36 | - | -257.28 | - | - | - | - | - | - |
| **Trend2** | - | 9.795** | - | -20.328*** | 8.185* | 9.242*** | - | 8.844** | - | - |
| | - | -3.06 | - | -3.38 | -3.74 | -2.6 | - | -3.07 | - | - |
| **_cons** | - | - | - | - | - | 30745.933* | - | - | - | - |
| | - | - | - | - | - | -15248.12 | - | - | - | - |

* p < 0.05, ** p < 0.01, *** p < 0.001
Standard errors are given below coffeicients in parenthesis.

**Table 7. Ports of Entry Along the U.S.-Mexico Border**

| Ports of Entry | Address |
|---|---|
| Hidalgo Texas Port of entry | 9901 S. Cage Boulevard<br>Suite B<br>Pharr, TX 78577 |
| Laredo, TX Port of Entry | Lincoln/Juarez Bridge, Administrative Bldg. #2<br>Laredo, TX 78040 |
| Eagle Pass, TX Port of Entry | 160 Garrison St.<br>Eagle Pass, TX 78852 |
| Del Rio, TX Port of Entry | International Bridge at Intersection of Spur 239 and Qualia Dr.<br>Del Rio, TX 78840 |
| Presidio, TX Port of Entry | Border Station Highway 67<br>PO Box 1959<br>Presidio, TX 79845 |
| Santa Teresa, NM Port of Entry | 170 Pete Domenici Hwy<br>PO Box1439<br>Santa Teresa, NM 88008 |
| Columbus, NM Port of Entry | State Highway 11<br>Mile Marker 0<br>Columbus, NM 88029 |
| Douglas, AZ Port of Entry | First Street and Pan American Avenue<br>Douglas, AZ 85607 |
| Nogales, AZ Port of Entry | 9 North Grand Ave.<br>Nogales, AZ 85621 |
| San Luis, AZ Port of Entry | Highway 95 & International Border<br>San Luis, AZ 85349 |

Source: US Customs and Border Protection 2014